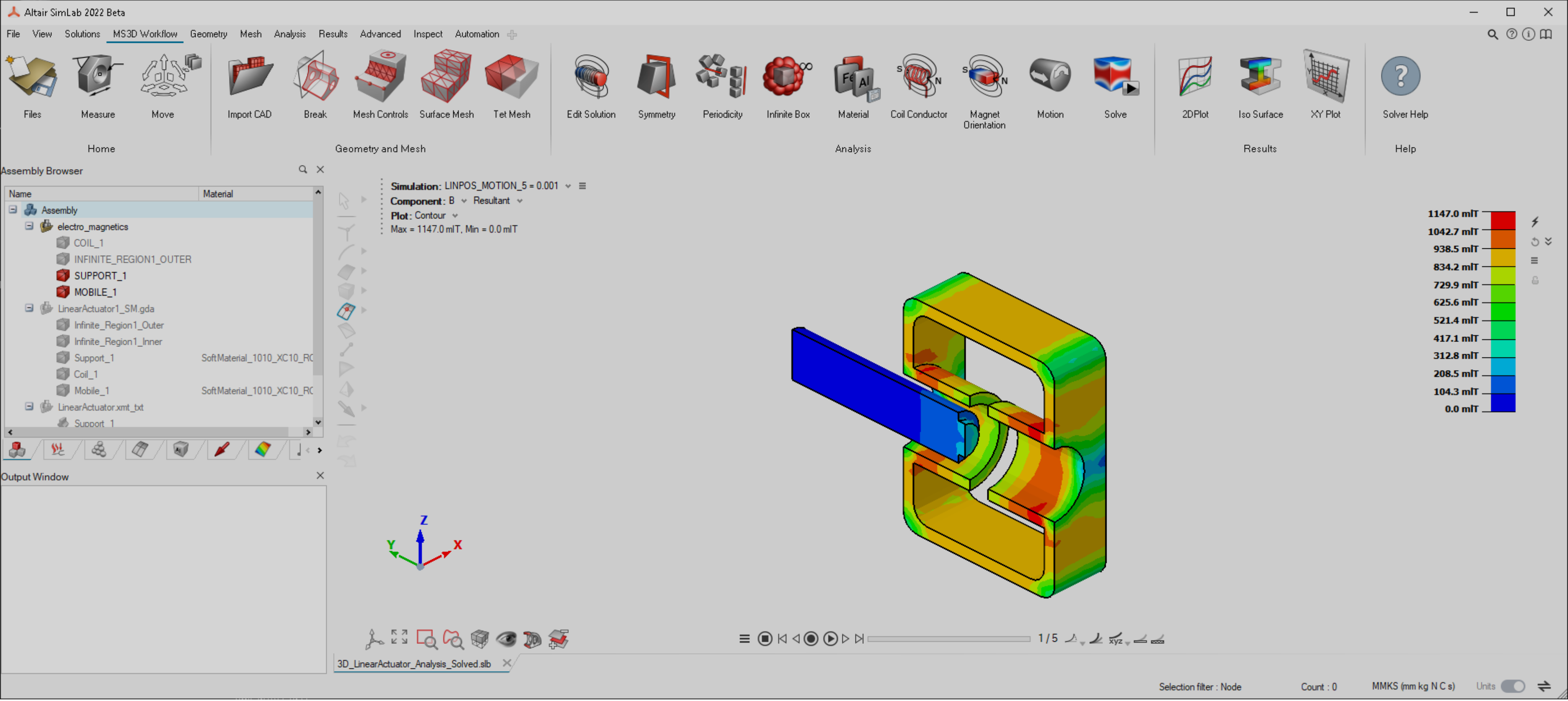


ALTAIR

LINEAR ACTUATOR (IN SIMLAB)

FLUX 3D MAGNETOSTATIC SOLUTION EXAMPLE

February 2026

TUTORIAL OUTLINE

I. INTRODUCTION

ALTAIR

INTRODUCTION – TO START

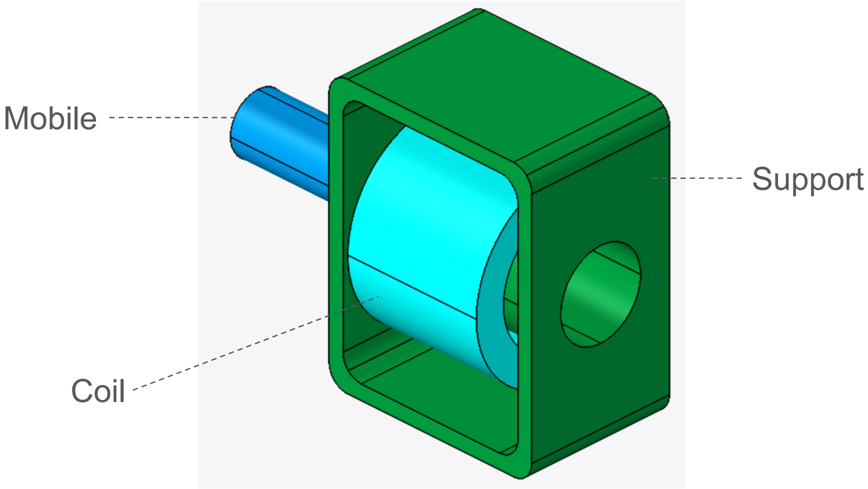
- Download the wished package: Tutorials package
- Unzip the package

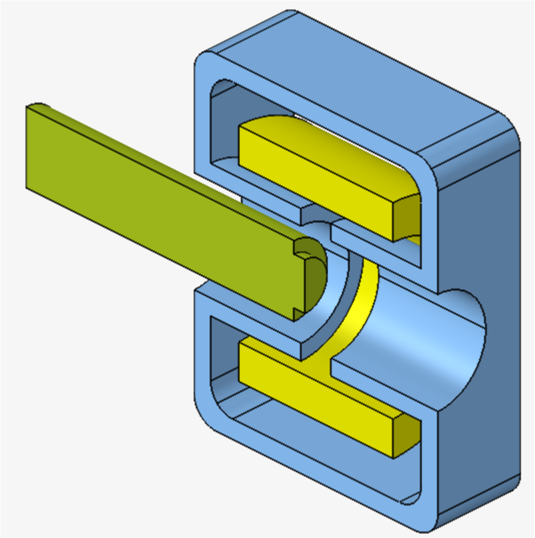
PACKAGE CONTENTS

- to follow the example step by step, the corresponding files are in **“[*Tutorial_name]*_StepByStep”** folder containing:
    - **Input** folder: contains initial ***.slb databases** / **other files needed** to be able to play manually the tutorial by following the **step by step document**
    - **Output** folder: empty (contains the **obtained results** after to play the tutorial)
    - **Tutorial** folder: contains the **document** describing the example **step by step**
- to play the tutorial by scripts, the corresponding files are in **“[*Tutorial_name]*_ PlayScripts”** folder containing:
    - **Input** folder: contains initial ***.slb databases** an **other files needed** to be able to **run scripts** of the tutorial
    - **Output** folder: empty (contains the **obtained results** after to play scripts of the tutorial)
    - **ScriptsTutorial** folder: contains **script files** to be able to play each analysis

INTRODUCTION

- Linear actuator – example from Flux 3D
  - The studied device is obtained from an import, it is a linear actuator with a coil, a mobile and a fixed part.





ALTAIR

INTRODUCTION – LINEAR ACTUATOR MODELING WORKFLOW

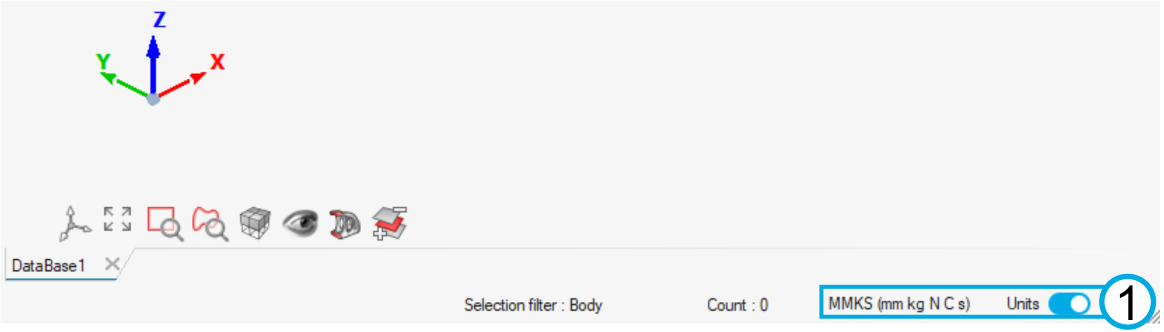
1 Create a MS3D solution
2 Import a CAD file
3 Break bodies (for symmetry)
4 Create surface mesh
5 Create volume mesh
6 Assign bodies to the solution
7 Create symmetry
8 Create and mesh infinite box
9 Create and assign material
10 Create coil conductor
11 Create motion
12 Solve the project
13 Postprocess the results [1]

[1] More postprocessing features for electromagnetic analysis are under development.

ACTIVATING UNIT SYSTEM

- In SimLab:
  - Activate mandatorily the unit system before creating a 3D magnetostatic solution

Step	Action
1	*In the bottom right corner in SimLab:* Check that the **Units: MMKS (mm kg N C s)** is activated

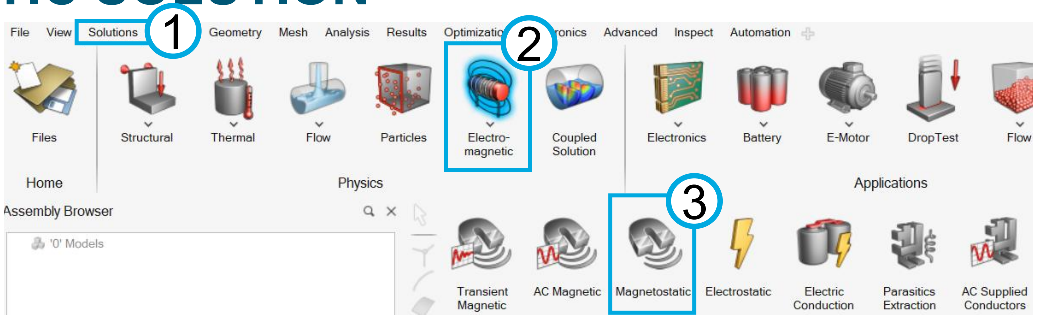


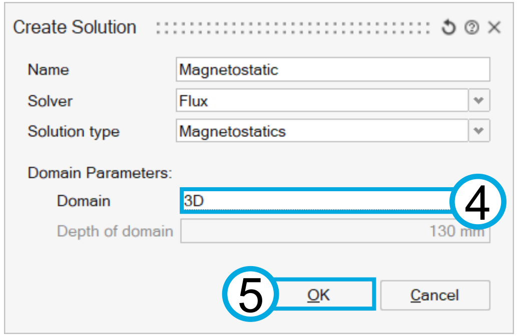
ALTAIR

CREATING 3D MAGNETOSTATIC SOLUTION

- Create a solution
  - Electromagnetics / 3D Magnetostatic solution

Step	Action
1	Click on the [Solutions] menu
2	Click on the [Electromagnetics] button
3	Click on the [magnetostatic] button
4	*In the Create Solution window:* In the **Domain** field, select [3D]
5	*In the Create Solution window:* Click on the [OK] button





ALTAIR

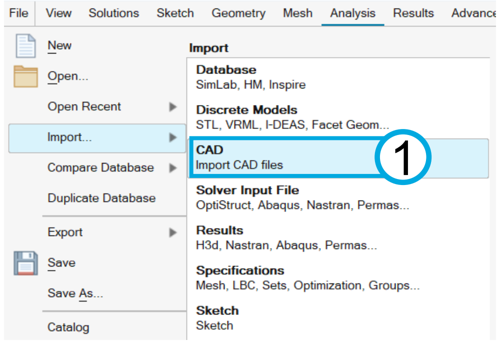
II. LINEAR ACTUATOR MODELING

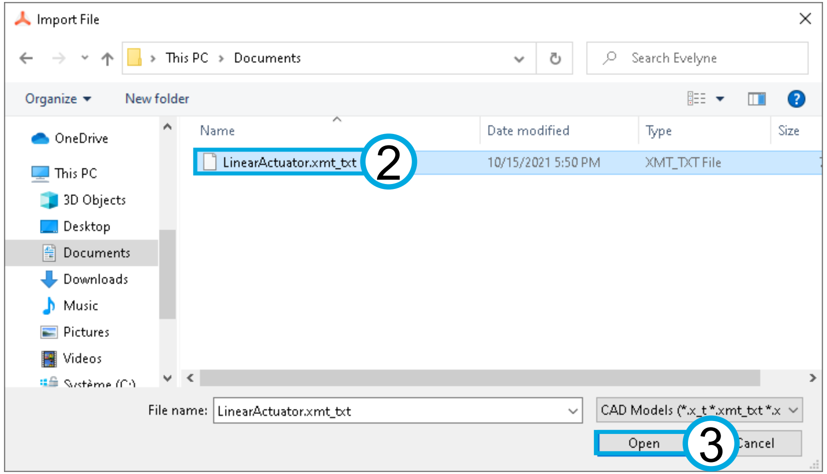
II.1 GEOMETRIC DESCRIPTION

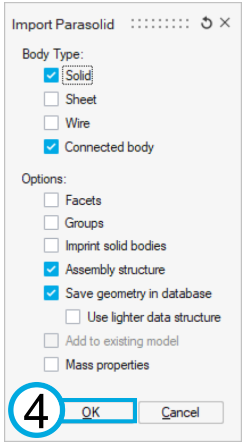
IMPORTING CAD FILE

- Import the CAD file "LinearActuator.xmt_txt"
  - Keeping the default values

Step	Action
1	Click on Import Cad Files Files → Import → CAD
2	*In the Import File window:* Select the [LinearActuator.xmt_txt] file
3	*In the Import File window:* Click on the [Open] button
4	*In the Import Parasolid window:* Click on the [OK] button



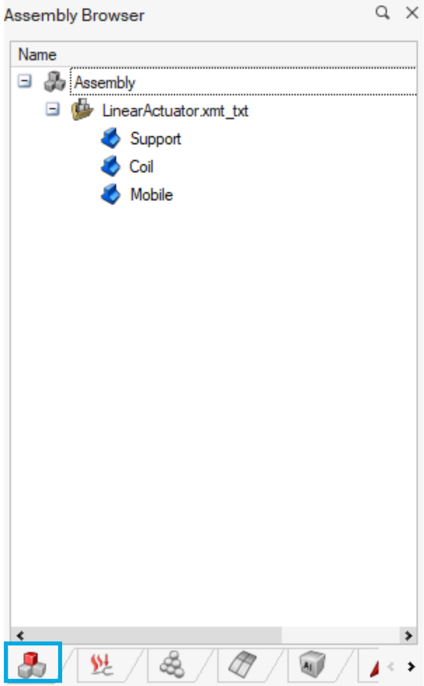


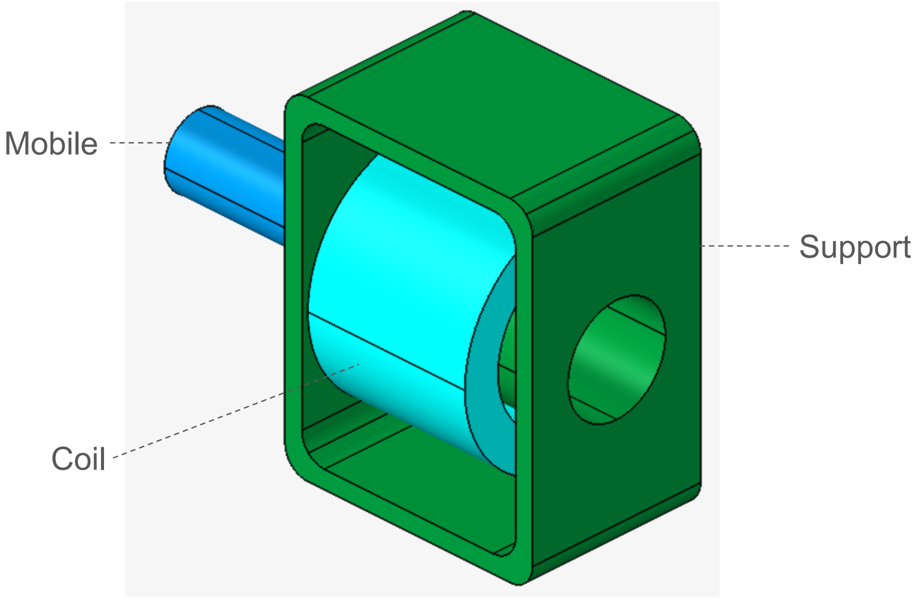


IMPORTING CAD FILE

- The "LinearActuator.xmt_txt" CAD file is imported:

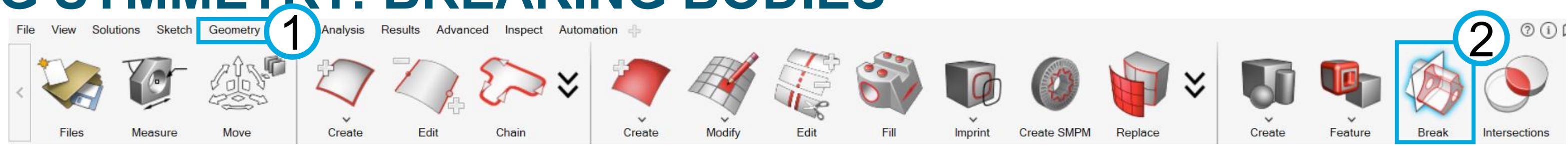
To the left of the graphic window, in the ***Assembly Browser****, 1st tab* ***Assembly****:*





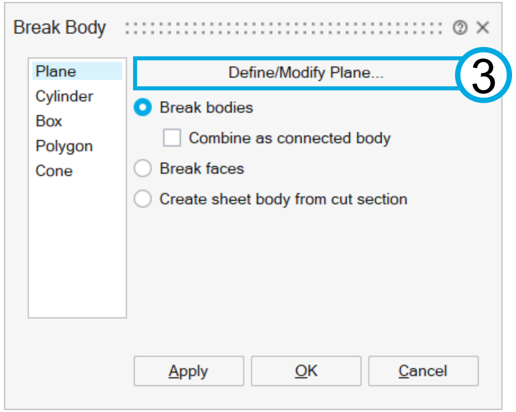
ALTAIR

CREATING SYMMETRY: BREAKING BODIES



- In the aim of defining a symmetry
  - Break all the bodies

Step	Action
1 - 2	In [Geometry] menu Click on [Break] button
3	*In the Break Body window:* Click on the [Define/Modify Plane] button

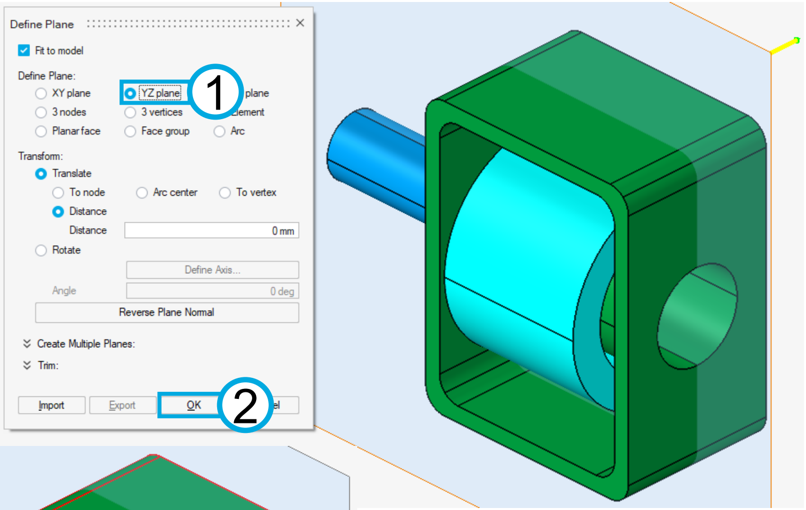


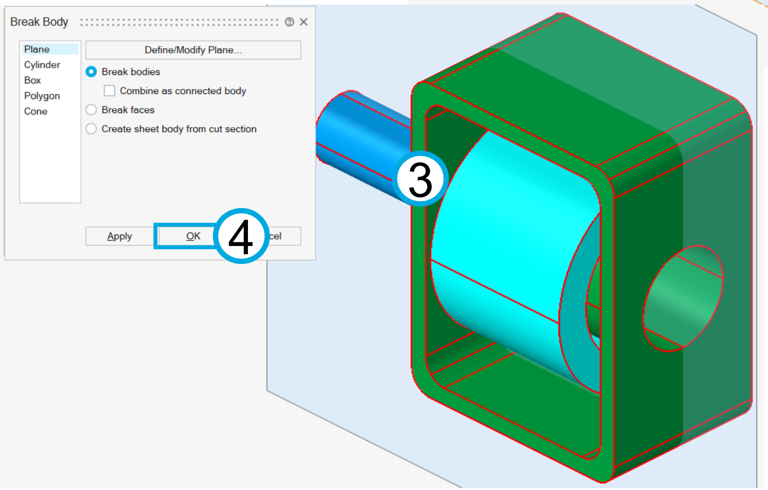
ALTAIR

CREATING SYMMETRY: BREAKING BODIES

- Break all the bodies
  - Along the YZ plane

Step	Action
1	*In the Define Plane window:* Select [YZ plane]
2	*In the Define Plane window:* Click on the [OK] button
3	Select all the bodies
4	*In the Break Body window:* Click on the [OK] button



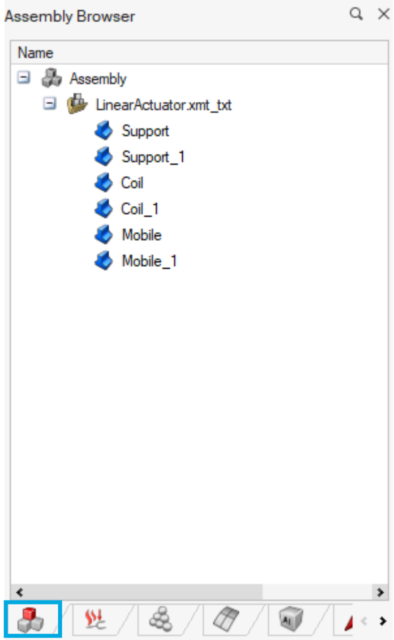


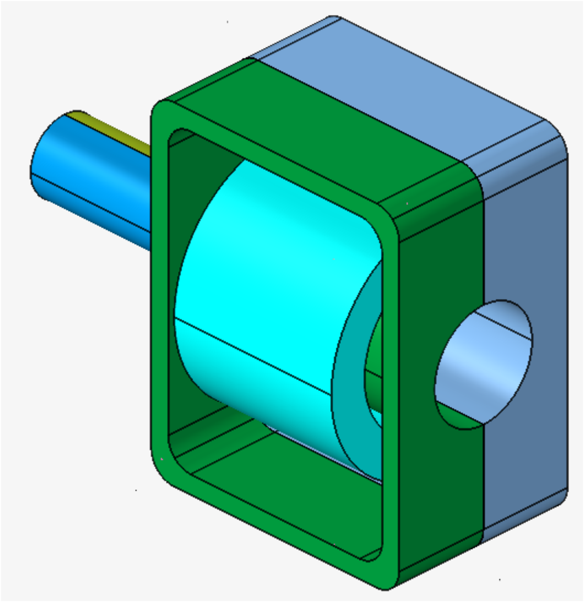
ALTAIR

CREATING SYMMETRY: BREAKING BODIES

- Break all the bodies
  - Each body is cut into 2 bodies:

To the left of the graphic window, in the ***Assembly Browser****, 1st tab* ***Assembly****:*

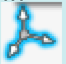
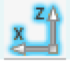


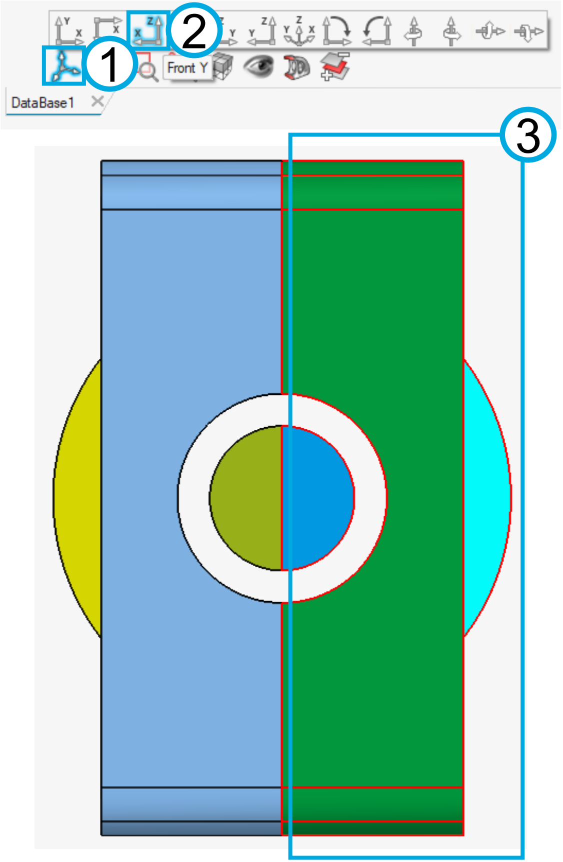


ALTAIR

CREATING SYMMETRY: DELETING USELESS BODIES

- Delete half of the bodies
  - Visualize and select them in the XZ plane

Step	Action
1	*In the bottom left corner of the graphic window:* Click on 
2	*In the bottom left corner of the graphic window:* Click on 
3	Select the bodies that are at the right of the YZ symmetry plane



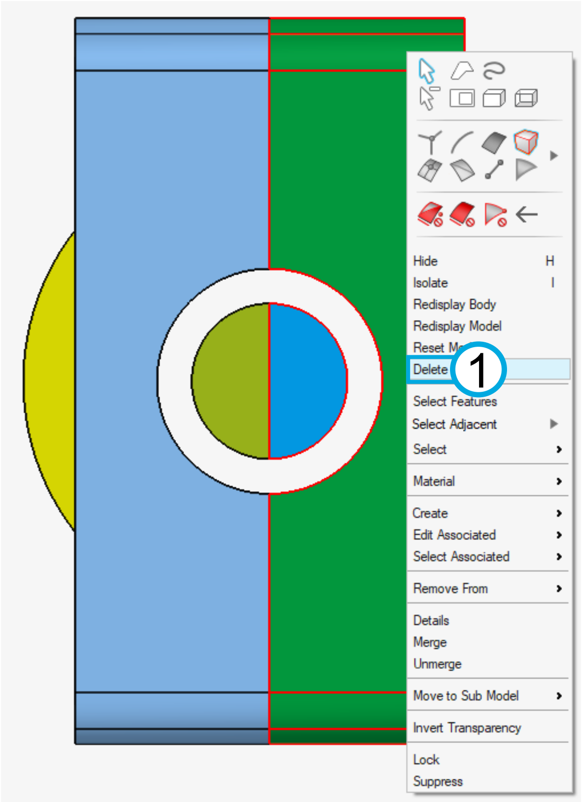
☞Note: It is possible to move the device with the middle-click and moving the mouse to position the device as you want.

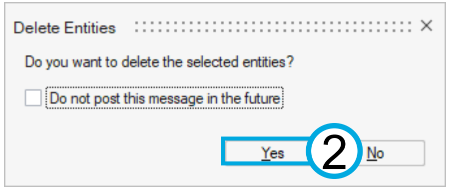
ALTAIR

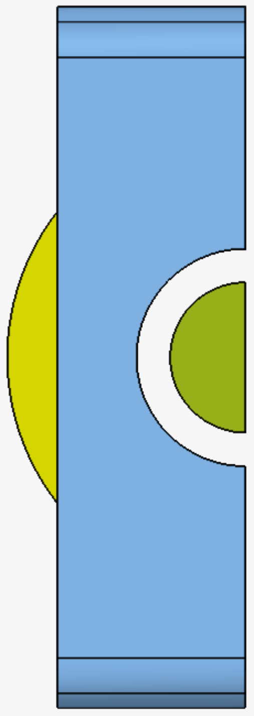
CREATING SYMMETRY: DELETING USELESS BODIES

- Delete half of the bodies

Step	Action
1	Right-click in the graphic window and select the [Delete] contextual menu
2	*In the Delete Entities window:* Click on the [Yes] button



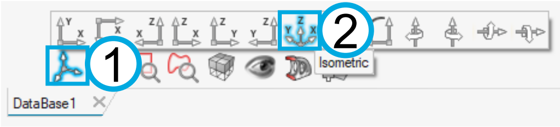




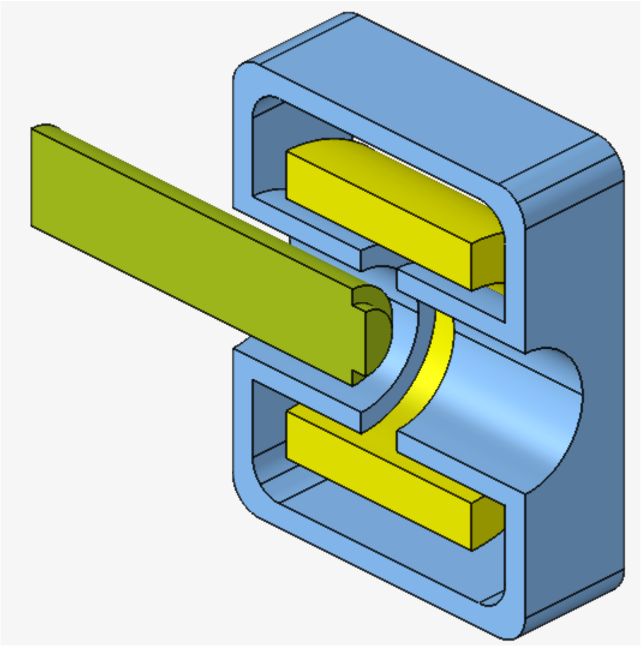
ALTAIR

CREATING SYMMETRY: DELETING USELESS BODIES

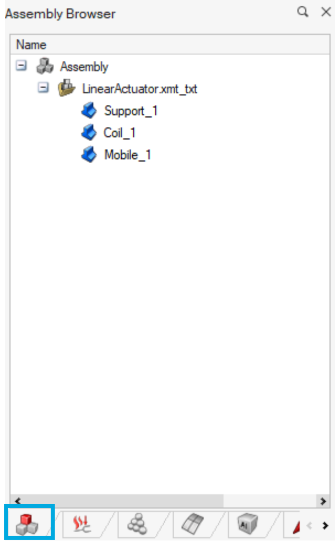
- Delete half of the bodies
  - Visualize the remaining bodies in the initial XYZ view



Step	Action
1	*In the bottom left corner of the graphic window:* Click on
2	*In the bottom left corner of the graphic window:* Click on



To the left of the graphic window, in the ***Assembly Browser****, 1st tab* ***Assembly****:*



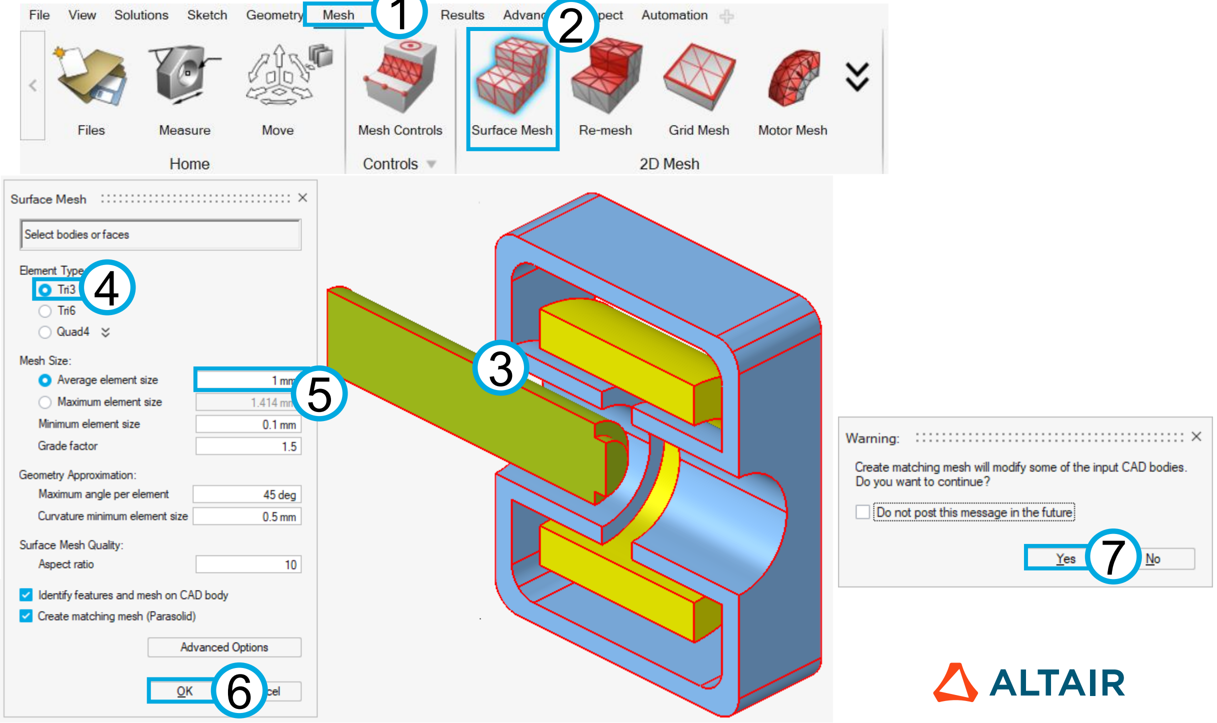
II.2 MESH DESCRIPTION

MESHING FACES

☞Note: There is no need to define a specific mesh on particular areas, so there is no need to use the [Mesh Controls] button.

- Mesh all the body faces
  - With 1st order triangular mesh elements and an element size of 1 mm

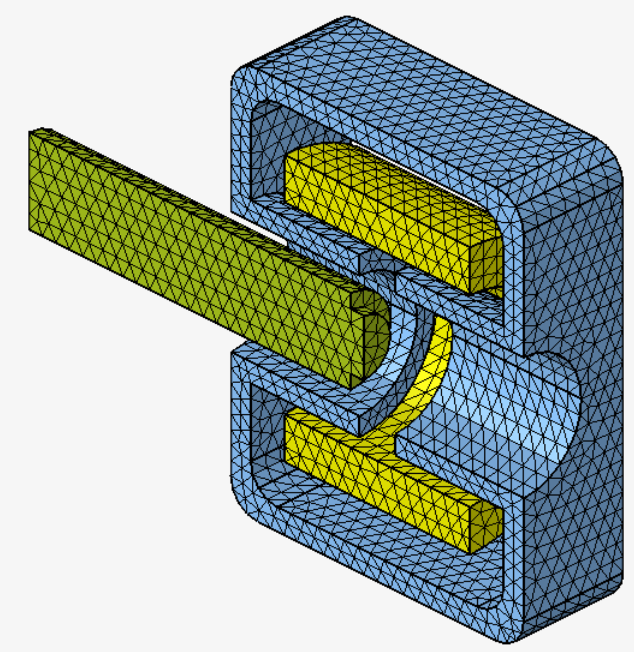
Step	Action
1-2	In [Mesh] menu Click on [Surface Mesh] button
3	Select all the bodies
4	*In the Surface Mesh window:* In **Element Type**, select [Tri3]
5	*In the Surface Mesh window:* In the **Average element size** field, enter `1 mm`
6	*In the Surface Mesh window:* Click on the [OK] button
7	*In the Warning window:* Click on the [Yes] button



ALTAIR

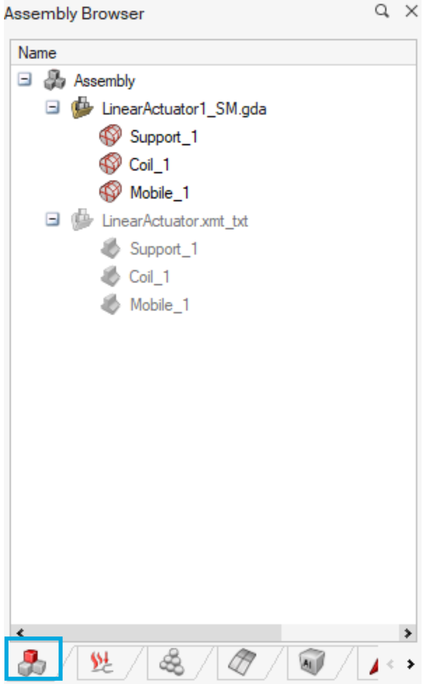
MESHING FACES

- All the body faces are meshed:



A .gda model has been created:

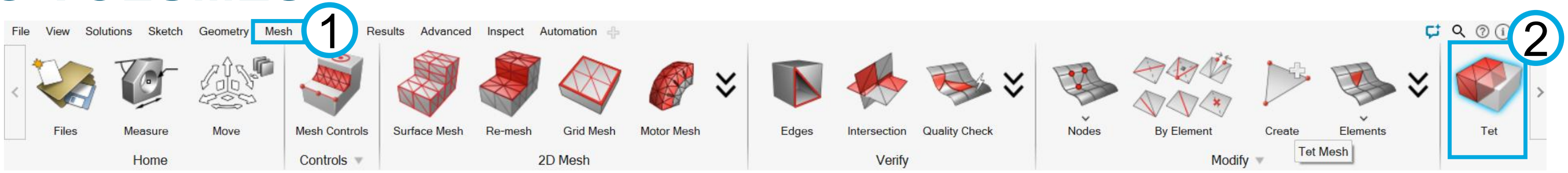
To the left of the graphic window, in the ***Assembly Browser****, 1st tab* ***Assembly****:*



This icon corresponds to a surface mesh

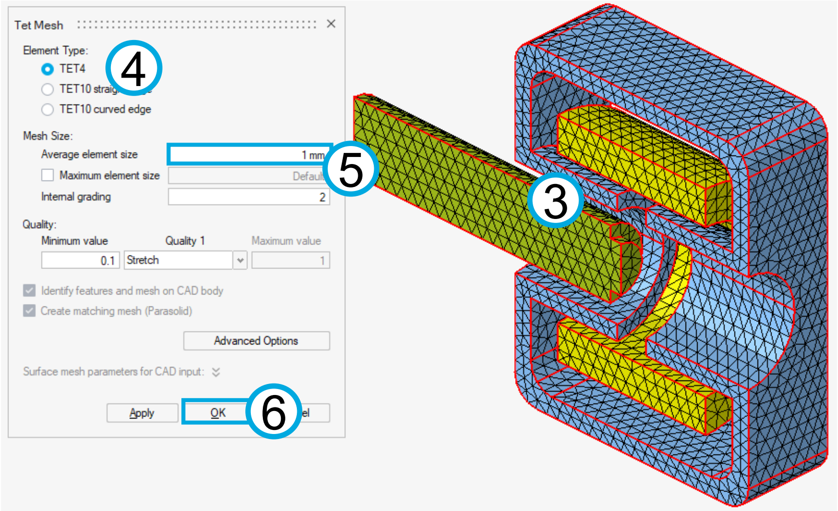
ALTAIR

MESHING VOLUMES



- Mesh all the body volumes
  - With 1st order tetrahedral mesh elements and an element size of 1 mm

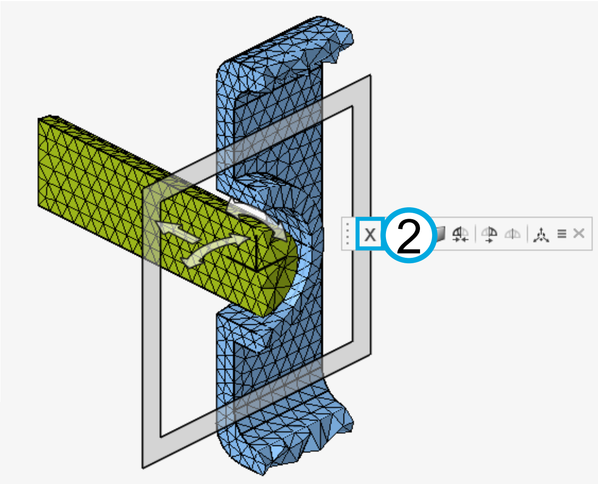
Step	Action
1-2	In [Mesh] menu Click on [Tet Mesh] button
3	Select all the bodies
4	*In the Tet Mesh window:* In **Element Type**, select [TET4]
5	*In the Tet Mesh window:* In the **Average element size** field, enter `1 mm`
6	*In the Tet Mesh window:* Click on the [OK] button

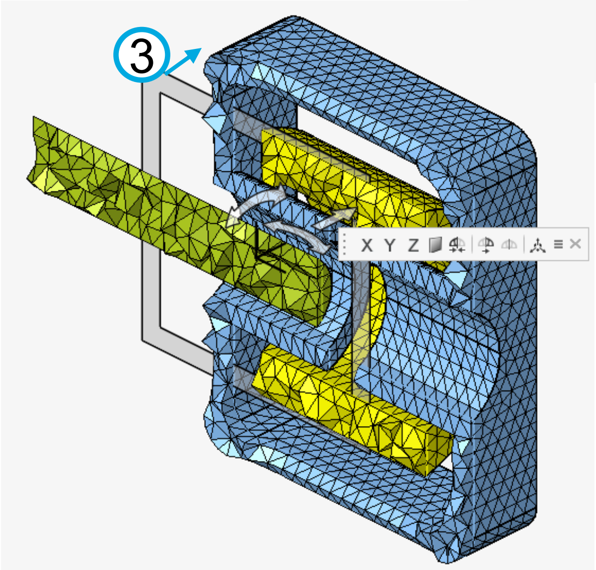


MESHING VOLUMES

- Visualize the volume mesh inside the bodies
  - All the body volumes are meshed:

Step	Action
1	*In the bottom left corner of the graphic window:* Click on
2	Click on X
3	Move the cutting plane



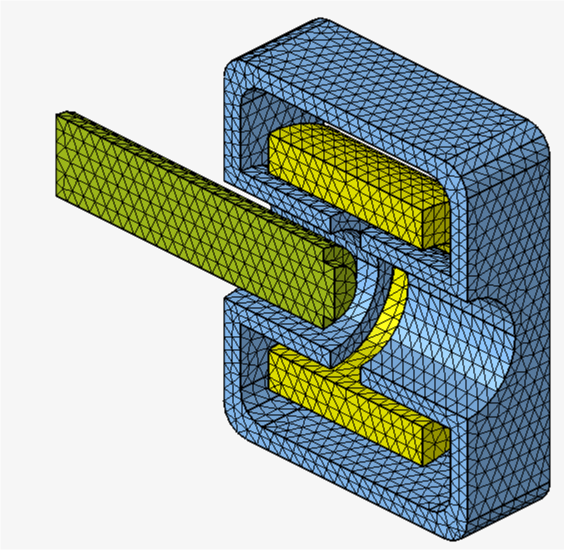


ALTAIR

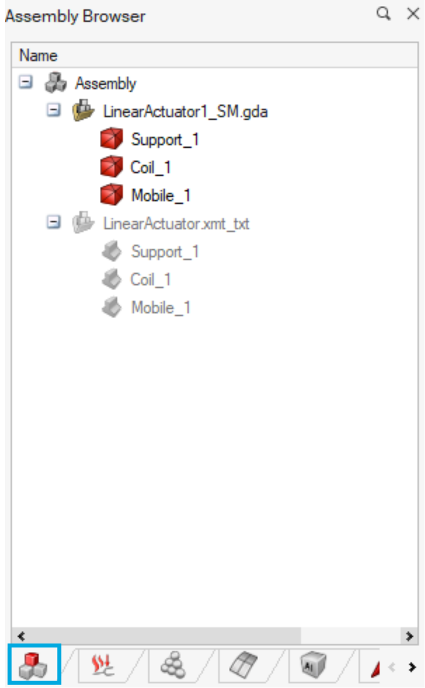
MESHING VOLUMES

- Disable the cutting plane

Step	Action
1	*In the bottom left corner of the graphic window:* Click on 



To the left of the graphic window, in the ***Assembly Browser****, 1st tab* ***Assembly****:*



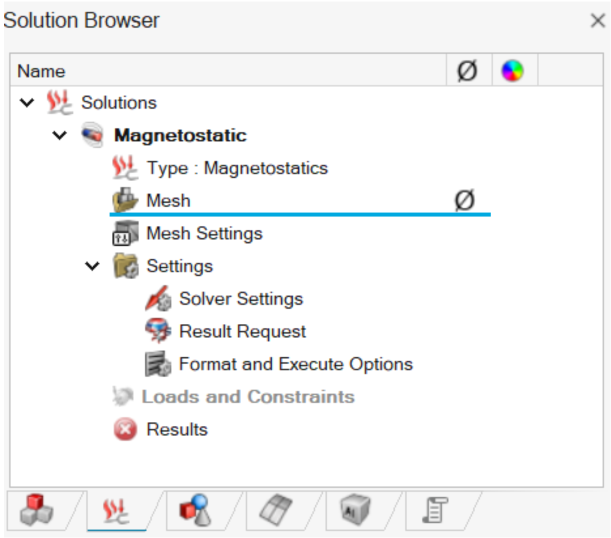
This icon corresponds to a volume mesh

II.3 PHYSICAL DESCRIPTION

EDITING SOLUTION

- Before assigning the meshed bodies to the solution

To the left of the graphic window, in the ***Solution Browser****, 2nd tab* ***Solutions****:*

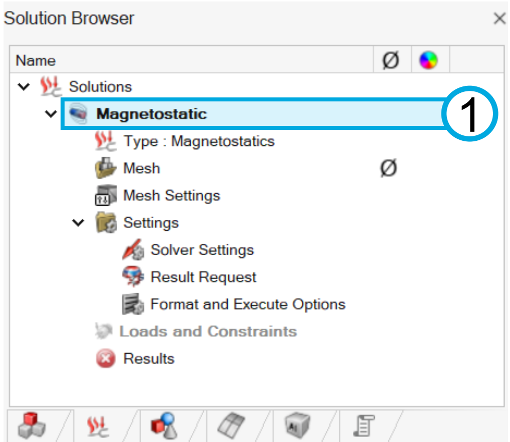


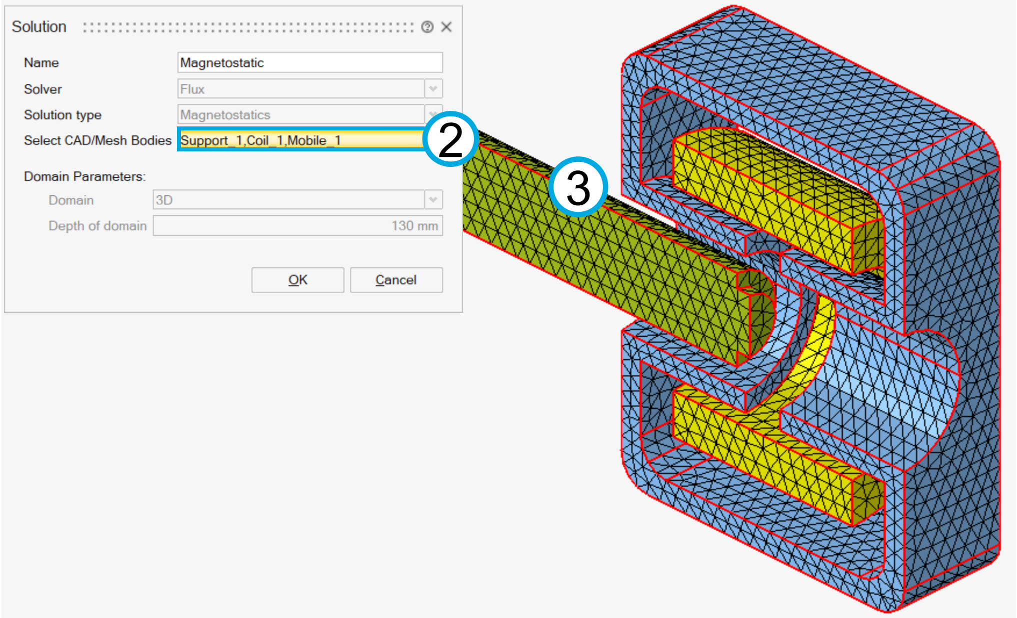
There is empty set ∅ next to ***Mesh***

EDITING SOLUTION

- Assign all the meshed bodies to the solution

Step	Action
1	In Solution Browser Double click on [Magnetostatic] solution
2	Select all the bodies
3	*In the Solution window:* Click on the [OK] button

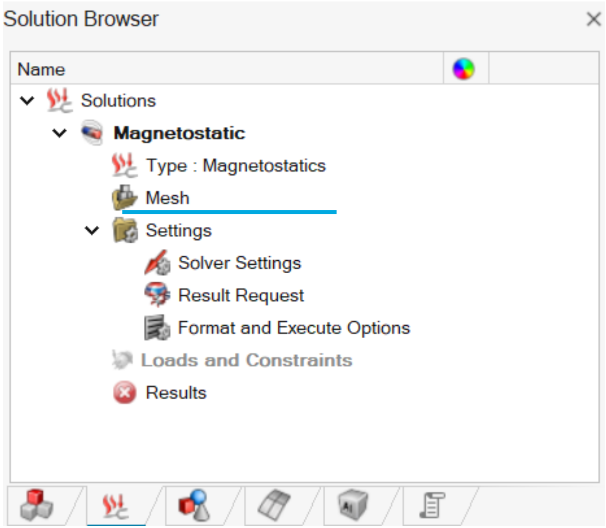




EDITING SOLUTION

- After assigning the meshed bodies to the solution

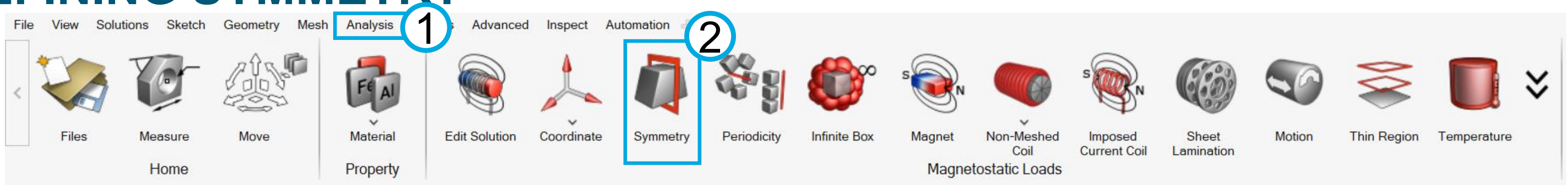
*To the left of the graphic window, in the **Solution Browser**, 2nd tab **Solutions**:*



*There is no more empty set ∅ next to **Mesh***

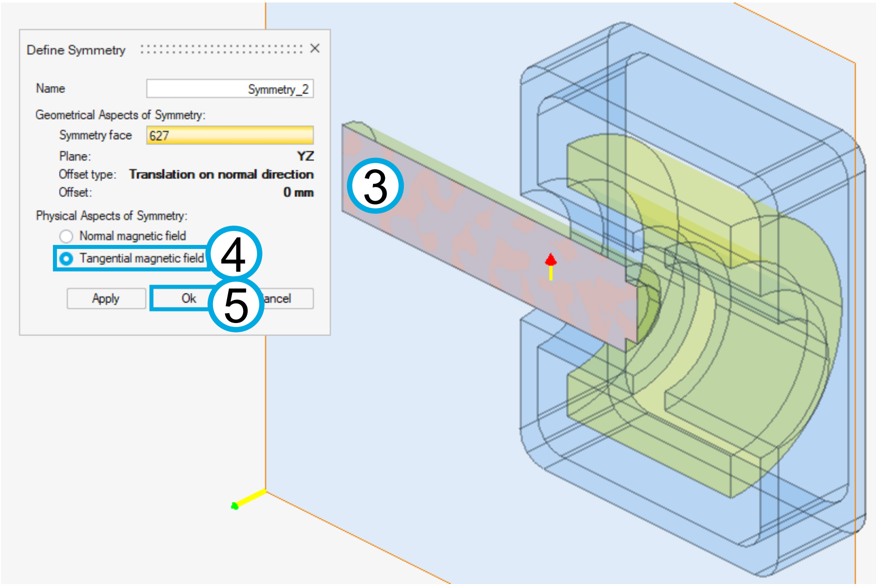
ALTAIR

DEFINING SYMMETRY



- Define the YZ symmetry
  - Geometrical and physical aspects

Step	Action
1-2	In [Analysis] menu Click on [Symmetry] button
3	Select a face on the symmetry plane
4	*In the Define Symmetry window:* Select [Tangential magnetic field]
5	*In the Define Symmetry window:* Click on the [OK] button

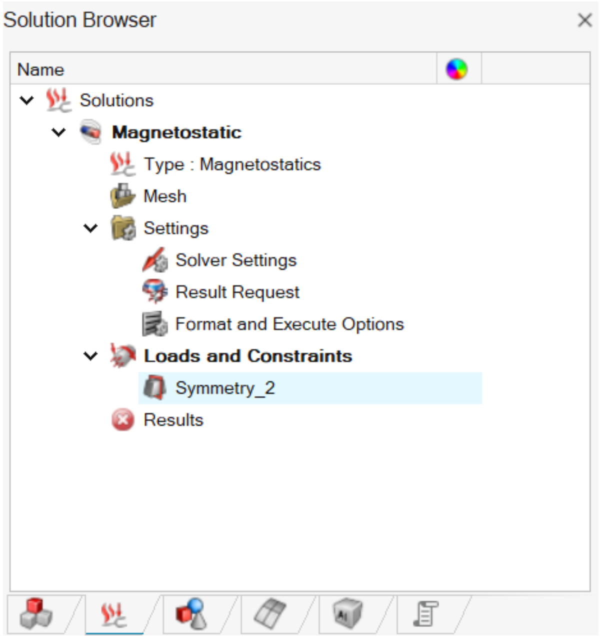


ALTAIR

DEFINING SYMMETRY

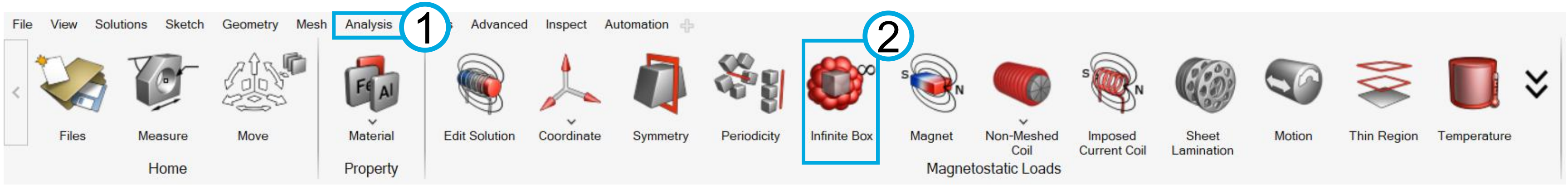
- The YZ symmetry is defined:

*To the left of the graphic window, in the **Solution Browser**, 2nd tab **Solutions**:*



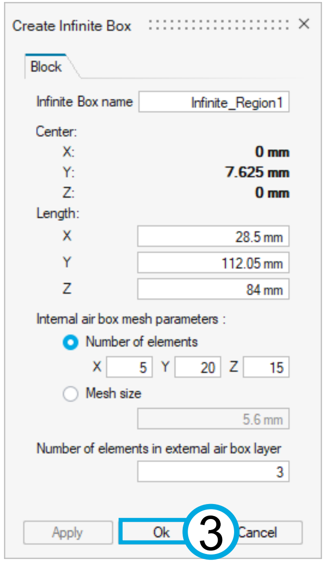
ALTAIR

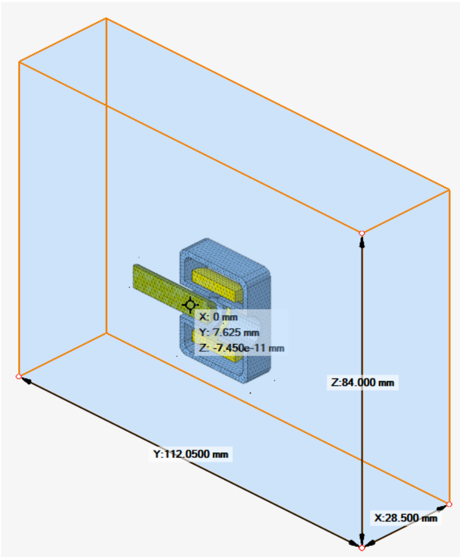
CREATING INFINITE BOX



- Create an infinite box
  - Keeping the default values

Step	Action
1-2	In [Analysis] menu Click on [Infinite Box] button
3	*In the Create Infinite Box window:* Click on the [OK] button

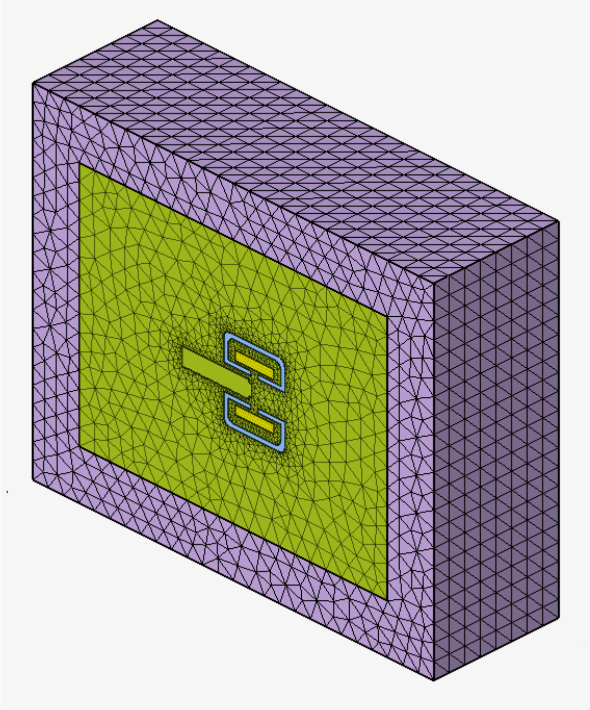




ALTAIR

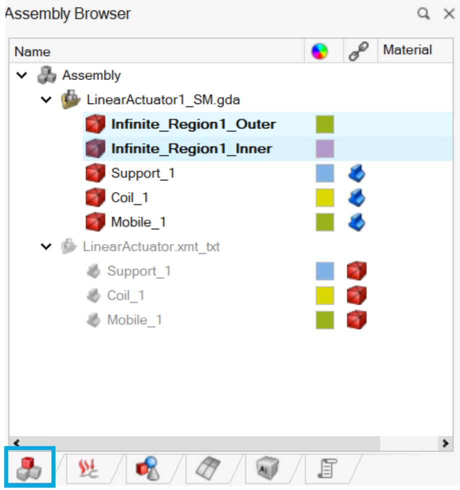
CREATING INFINITE BOX

- The infinite box is created and meshed:

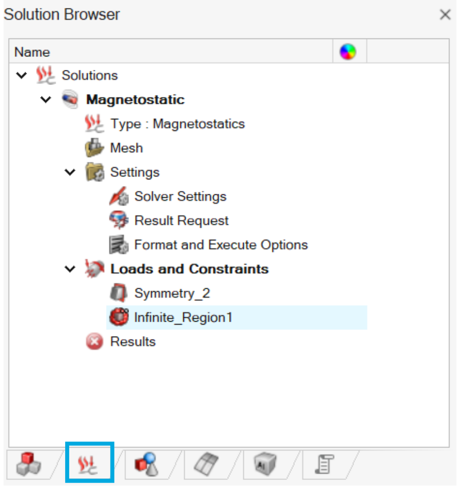


To the left of the graphic window:

*in the **Assembly Browser***
*1st tab **Assembly**:*



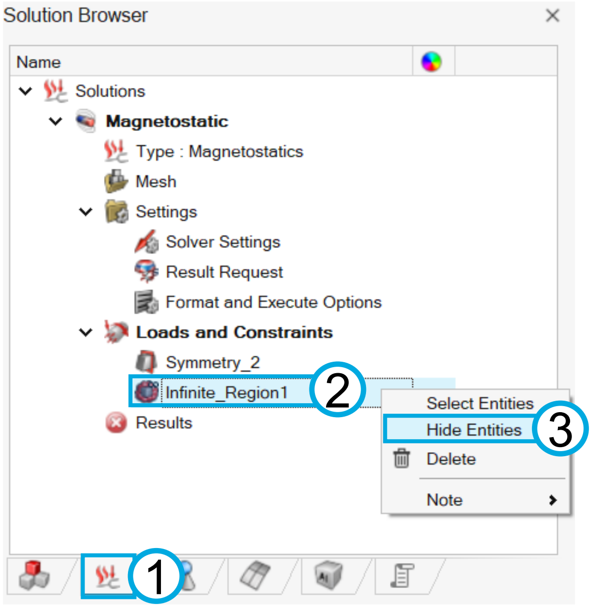
*in the **Solution Browser***
*2nd tab **Solutions**:*

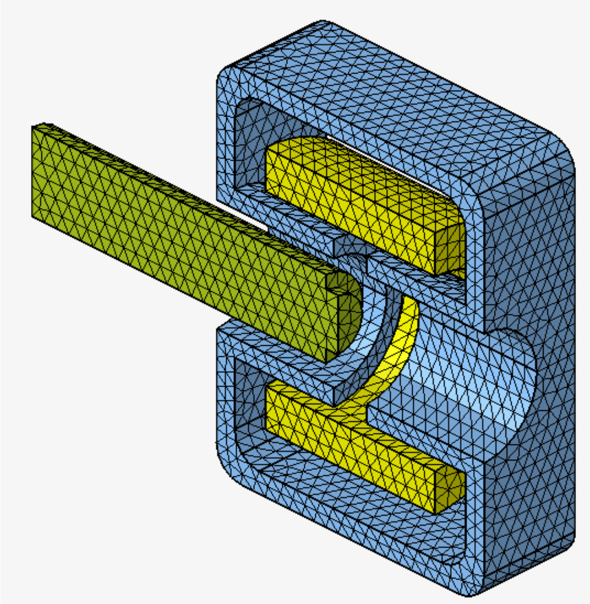


HIDING INFINITE BOX

- Hide the infinite box

Step	Action
1	*To the left of the graphic window, in the **Solution Browser**:* Select the 2nd tab **Solutions**
2	Select [Infinite_Region1]
3	Right-click and select the [Hide Entities] contextual menu



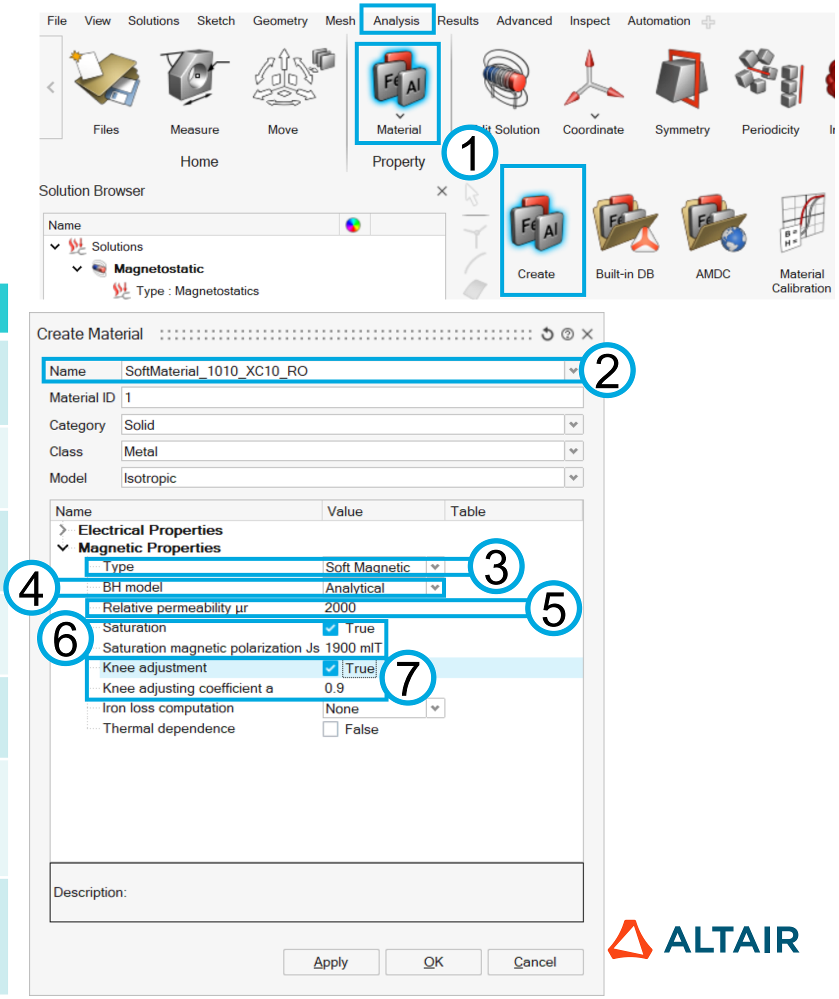


ALTAIR

CREATING MATERIAL

- Create a soft magnetic material with a non-linear B(H) curve

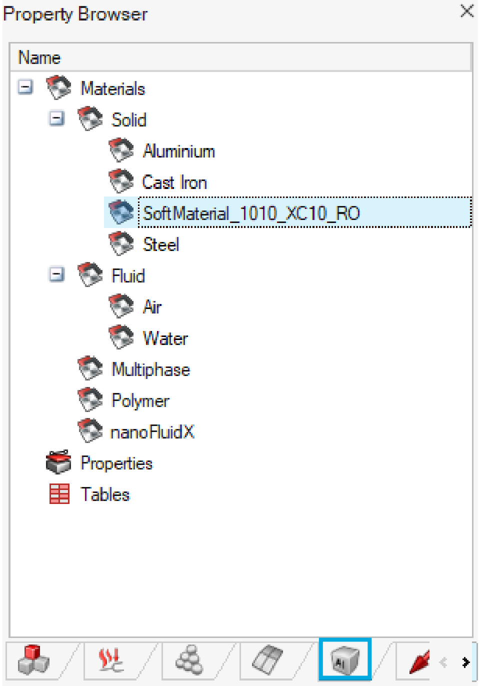
Step	Action
1	In [Analysis] menu Click on [Material] → [Create] button
2	*In the Create Material window:* In the **Name** field, enter `SoftMaterial_1010_XC10_RO`
3	*In the Create Material window:* In the **Type** field, select [Soft Magnetic]
4	*In the Create Material window:* In the **BH model** field, select [Analytic]
5	*In the Create Material window:* In the **Relative permeability μr** field, enter `2000`
6	*In the Create Material window:* Set the **Saturation** at **True** and In the **Saturation magnetization** field, enter `1.9` T
7	*In the Create Material window:* Set the **Knee adjustment** at **True** and in the **Knee adjustment coefficient** field, enter `0.9`



CREATING MATERIAL

- The soft magnetic material "SoftMaterial_1010_XC10_RO“ has been created:

*To the left of the graphic window, in the **Property Browser**, 5th tab **Property**:*

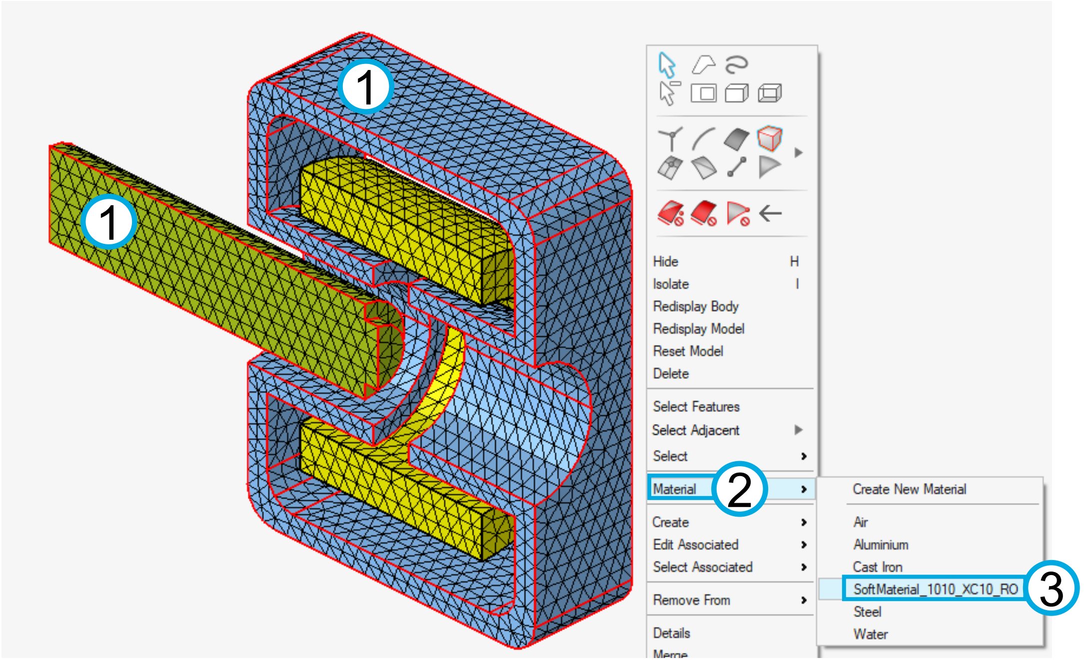


ALTAIR

ASSIGNING MATERIAL

- Assign the created soft magnetic material to the Mobile_1 and Support_1 bodies

Step	Action
1	Select the Mobile_1 body and the Support_1 body
2	Right-click in the graphic window and select the [Material] contextual menu
3	Select [SoftMaterial_1010_XC10_RO]



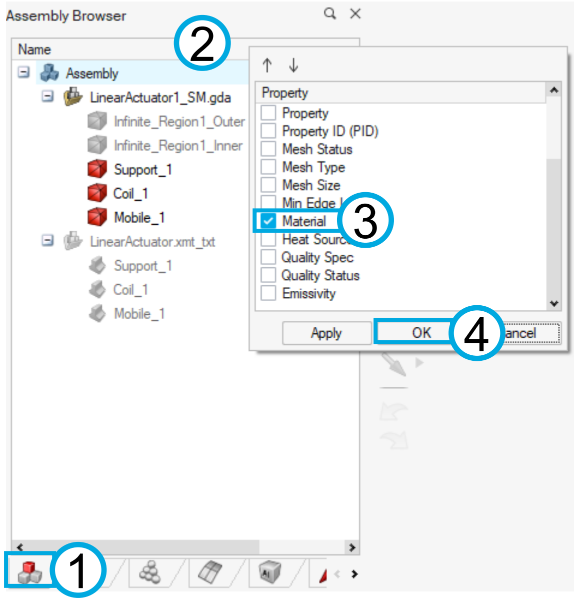
☞Note: On the left side of the graphic window, there is the graphic selection choice.
In order to select a body graphically, the Body icon must be selected.

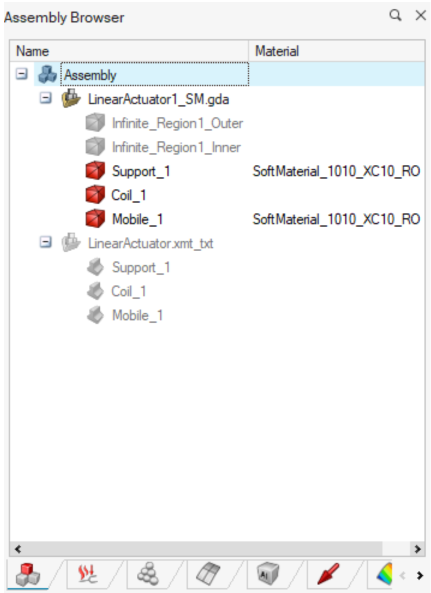
ALTAIR

ASSIGNING MATERIAL

- The material is assigned to the 2 bodies

Step	Action
1	*To the left of the graphic window, in the* ***Assembly Browser****:* Select the 1st tab **Assembly**
2	Right-click on the [Name] column title bar
3	Check the [Material] box
4	Click on the [OK] button

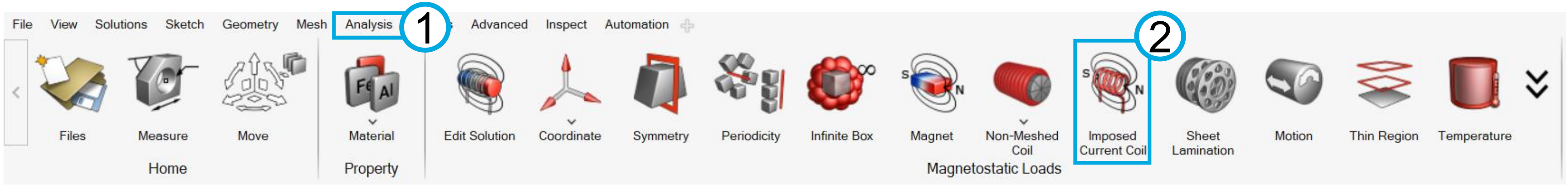




☞Note: If needed, it is possible to modify the material assigned to a body, by clicking in the tree, in front of the body (of the.gda model) and selecting the material you want to assign to this body.

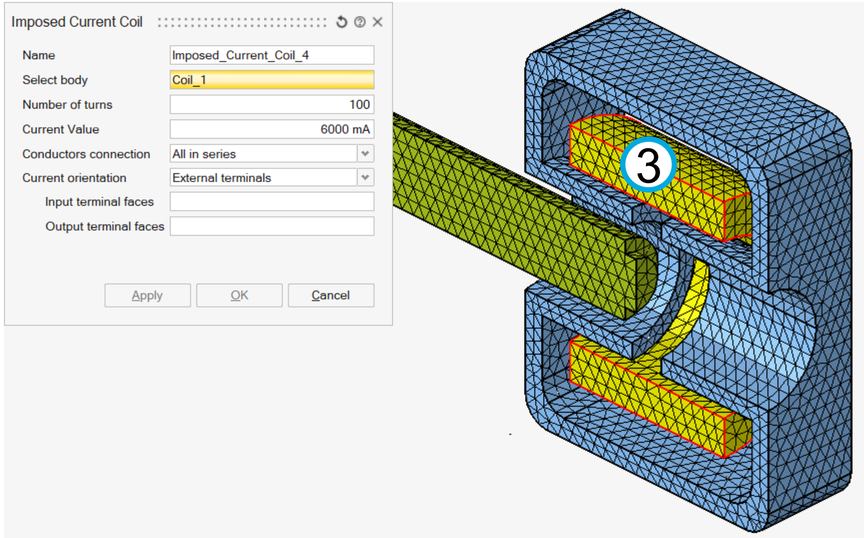
ALTAIR

CREATING COIL CONDUCTOR



- Create the coil conductor

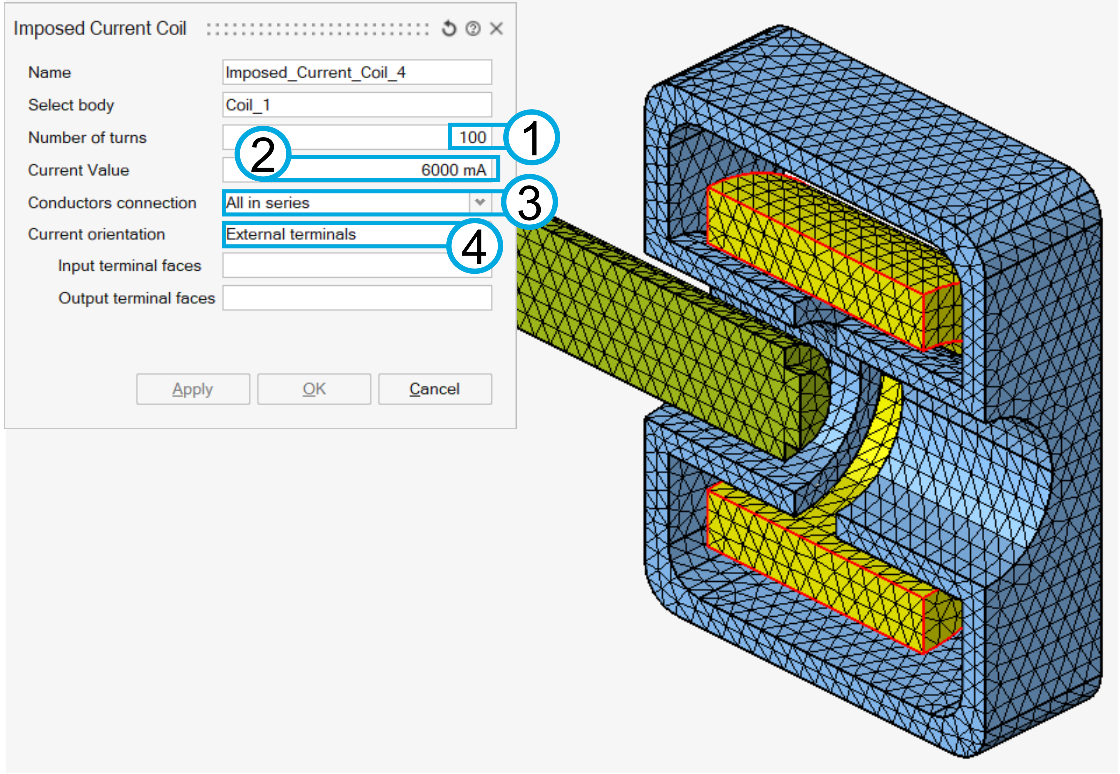
Step	Action
1	In [Analysis] menu Click on [Imposed Current Coil] button
2	Click on the [Coil Conductor] button
3	Select the Coil_1 body



CREATING COIL CONDUCTOR

- Create the coil conductor
  - 100 turns, 6 A

Step	Action
1	*In the Coil Conductor window:* In the **Number of turns** field, enter `100`
2	*In the Coil Conductor window:* In the Current **Value** field, enter `6000` mA
3	*In the Coil Conductor window:* In the **Conductors connection** field, select [All in series]
4	*In the Coil Conductor window:* In the **Current orientation** field, select [External terminals]

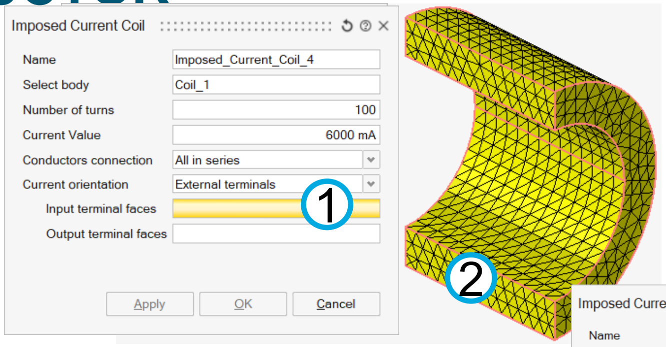


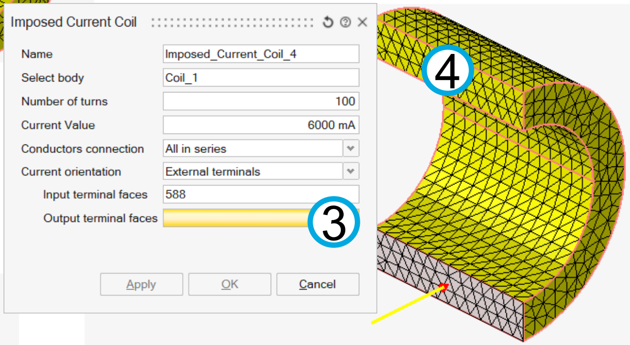
ALTAIR

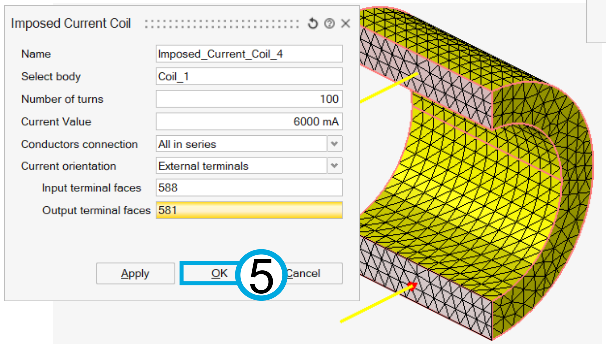
CREATING COIL CONDUCTOR

- Create the coil conductor
  - Input and output terminal faces

Step	Action
1	*In the Coil Conductor window:* Click in the **Input terminal faces** field
2	Select the input face
3	*In the Coil Conductor window:* Click in the **Output terminal faces** field
4	Select the output face
5	*In the Coil Conductor window:* Click on the [OK] button





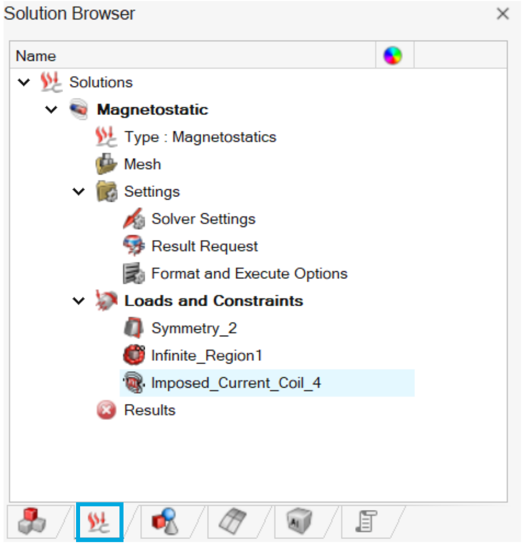


ALTAIR

CREATING COIL CONDUCTOR

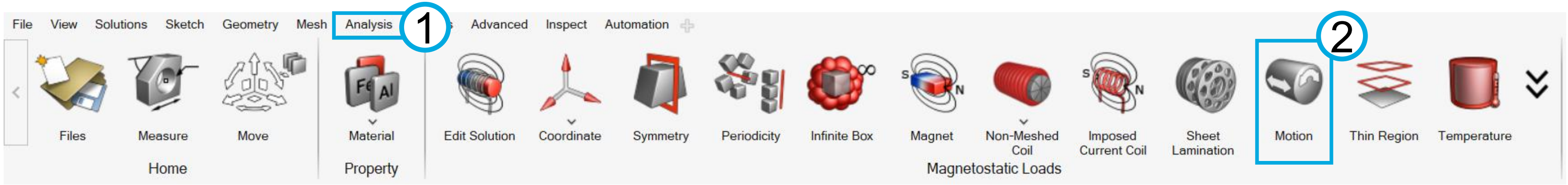
- The coil conductor has been created

To the left of the graphic window, in the ***Solution Browser****, 2nd tab* ***Solutions****:*



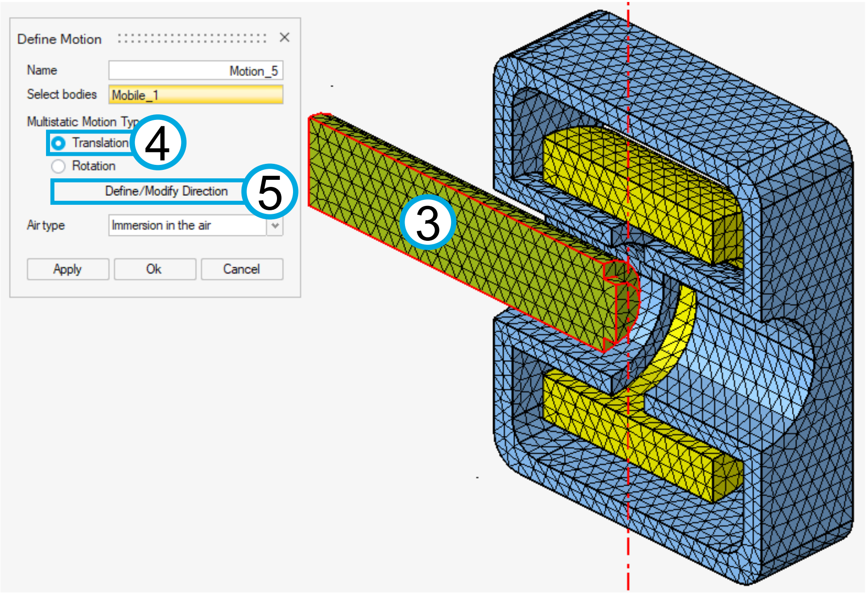
☞Note: There is no magnet in this device, so there is no need to use the [Magnet Orientation] button.

CREATING MOTION



- Create a motion
  - Translation

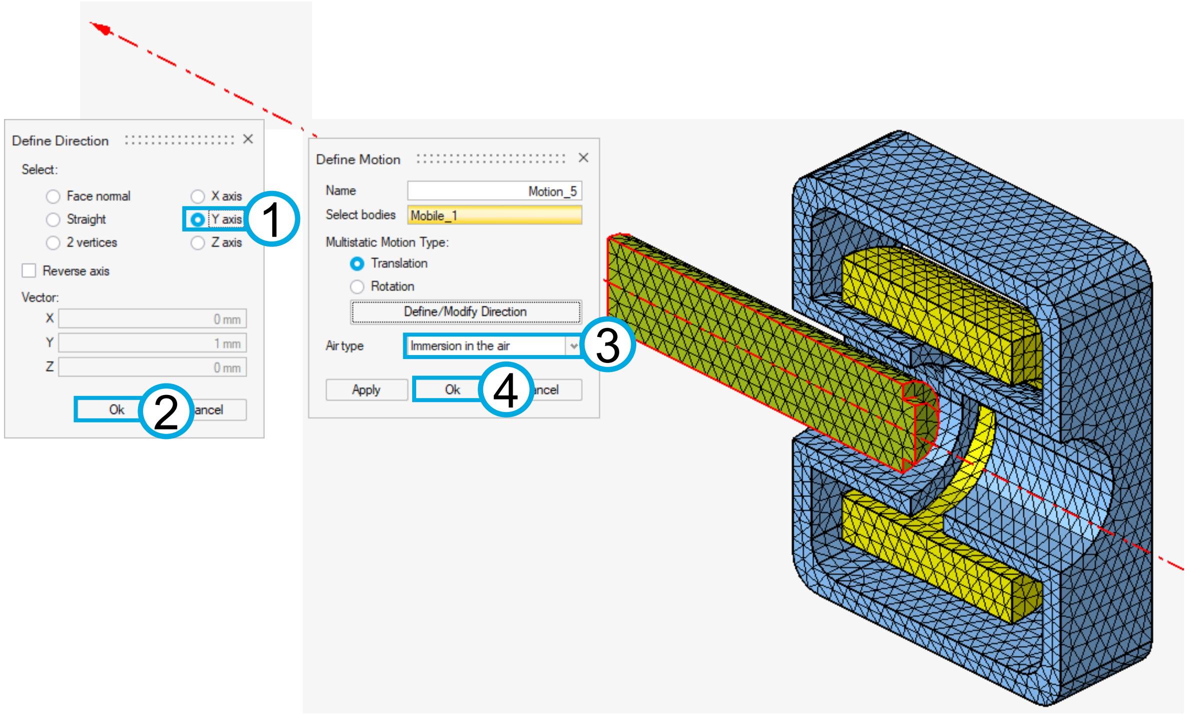
Step	Action
1	In [Analysis] menu Click on [Motion] button
2	Click on the [Motion] button
3	Select the moving body: Mobile_1
4	*In the Define Motion window:* For the **Multistatic Motion Type**, select [Translation]
5	*In the Define Motion window:* Click on the [Define/Modify Direction] button



CREATING MOTION

- Create a motion
  - Along Y axis

Step	Action
1	*In the Define Direction window:* Select [Y axis]
2	*In the Define Direction window:* Click on the [OK] button
3	*In the Define Motion window:* In the **Air type** field, select [Immersion in the air]
4	*In the Define Motion window:* Click on the [OK] button



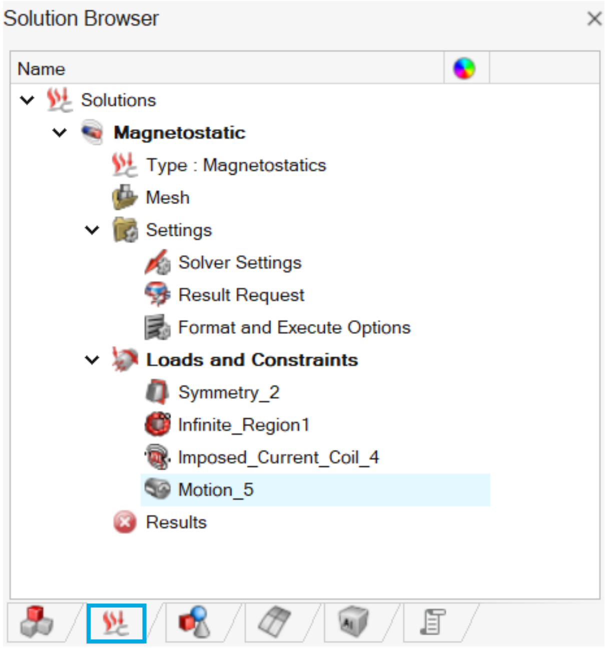
☞Note: It is possible to change the movement direction by checking the [Reverse axis] box.

ALTAIR

CREATING MOTION

- The motion has been created:

To the left of the graphic window, in the ***Solution Browser****, 2nd tab* ***Solutions****:*



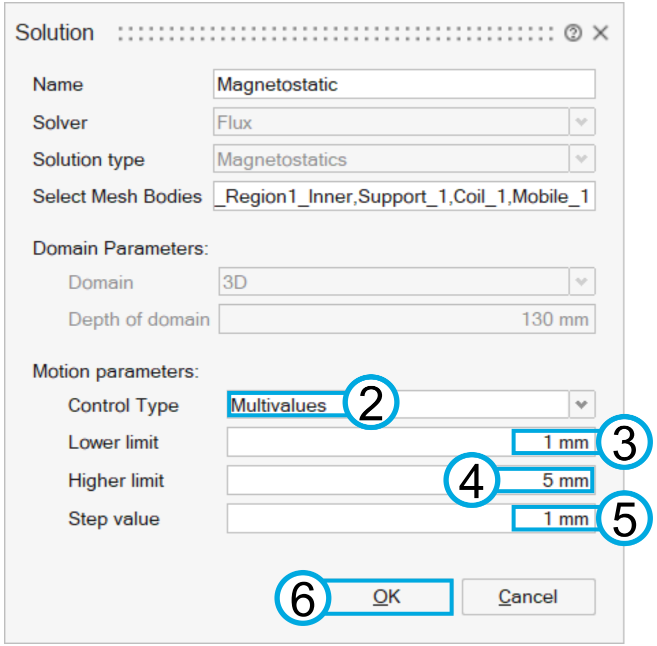
ALTAIR

II.4 SOLVING PROCESS

PARAMETERIZING SOLVING PROCESS

- Edit Solution
  - Multivalues: from 1 mm to 5 mm by step of 1 mm

Step	Action
1	In Solution Browser Double click on [Magnetostatic] solution
2	*In the Solution window:* In the **Control Type** field, select [Multivalues]
3	*In the Solution window:* In the **Lower limit** field, enter `1` mm
4	*In the Solution window:* In the **Higher limit** field, enter `5` mm
5	*In the Solution window:* In the **Step value** field, enter `1` mm
6	*In the Solution window:* Click on the [OK] button

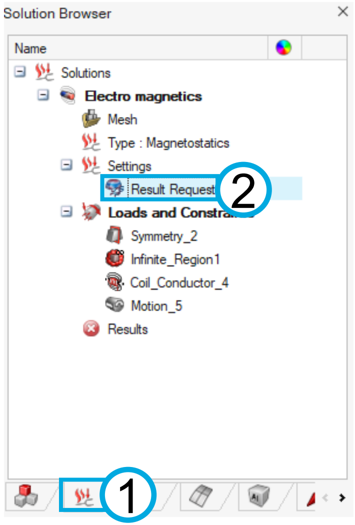


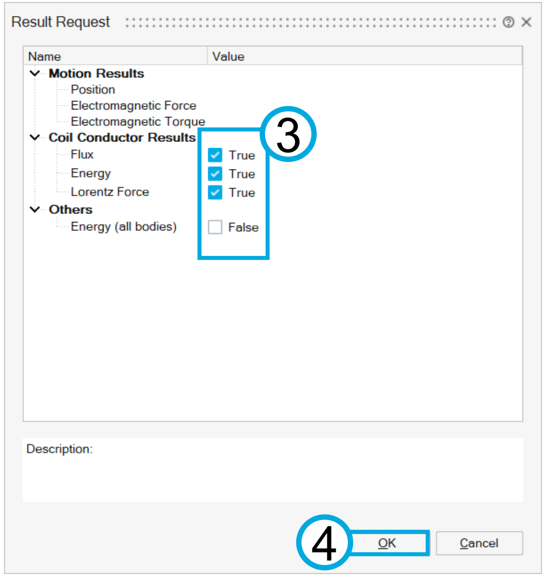
ALTAIR

RESULT REQUEST

- The **Result Request** allows you to choose the global quantities to be computed during the solving process in order to postprocess these selected global quantities.
- By default, all possible quantities are selected.
- The **Result Request** is created directly after creating the EM solution and the user can deselect quantities.

Optional steps (if you do not want to compute all global quantities)	
Step	**Action**
1	*To the left of the graphic window, in the **Solution Browser**:* Select the 2nd tab **Solutions**
2	Double-click on [Result Request]
3	*In the Result Request window:* Uncheck unwanted quantities
4	Click on the [OK] button





ALTAIR

SAVING DATABASE

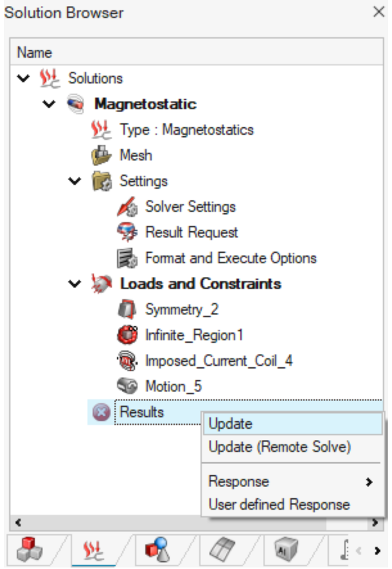
- Save the project “Ready To Solve”

Step	Action
1	Click on **File → Save as**
2	Save the project **3D_MS_LinearActuator_rts.slb** in *...\3D_MS_LinearActuator\3D_MS_LinearActuator_StepByStep\Output*

RUNNING SOLVING PROCESS

- Run the solving process

Step	Action
1	*In Solution Browser* Right click on **Results** node and select **Update**



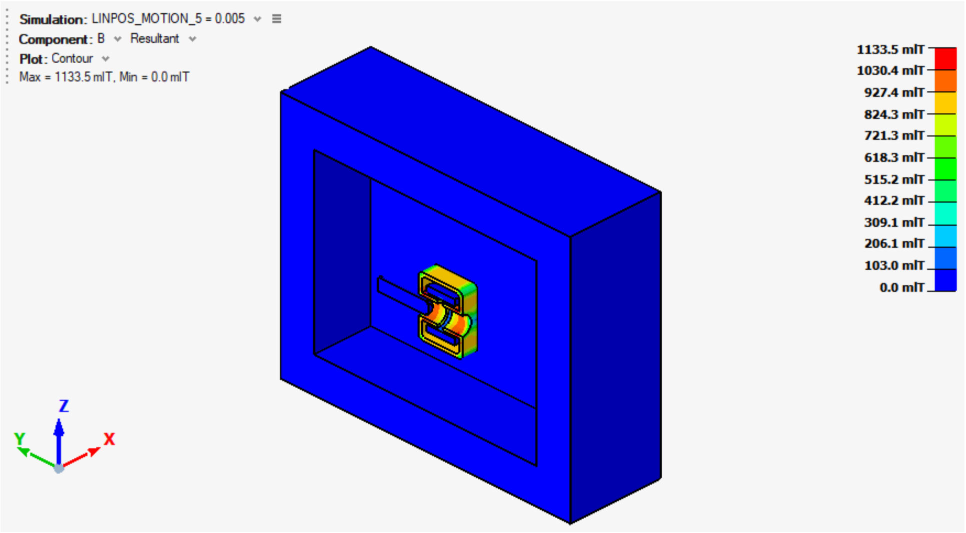
☞ Note:

The solving process takes about 2 min depending on the computer on which it is run.

ALTAIR

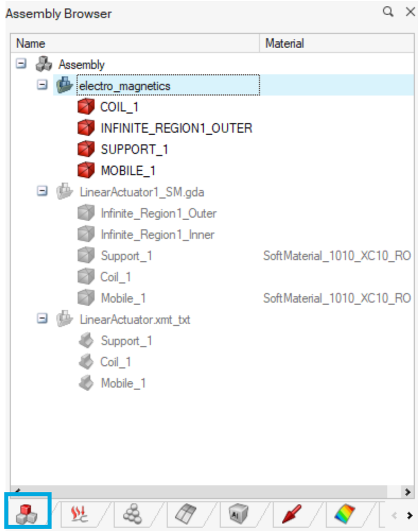
RUNNING SOLVING PROCESS

- The solving process is completed

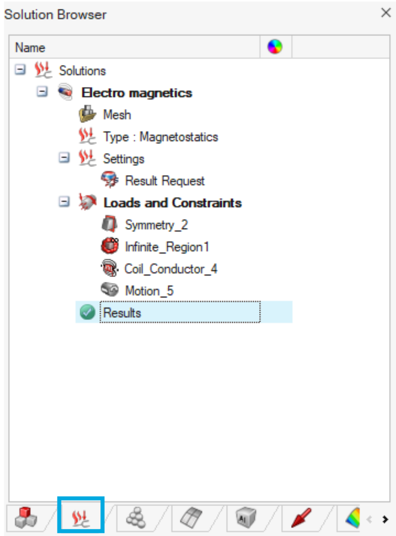


To the left of the graphic window:

*in the **Assembly Browser***
*1st tab **Assembly**:*



*in the **Solution Browser***
*2nd tab **Solutions**:*



☞Notes:

Results means that the solving process is completed

Results means that the solving process is in progress

ALTAIR

SAVING DATABASE

- Save the “Solved” database

Step	Action
1	Click on **File → Save as**
2	Save the project **3D_MS_LinearActuator_solved.slb** in *...\3D_MS_LinearActuator\3D_MS_LinearActuator_StepByStep\Output*

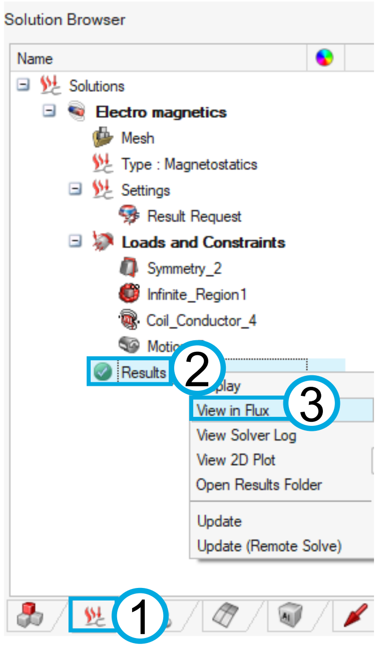
ALTAIR

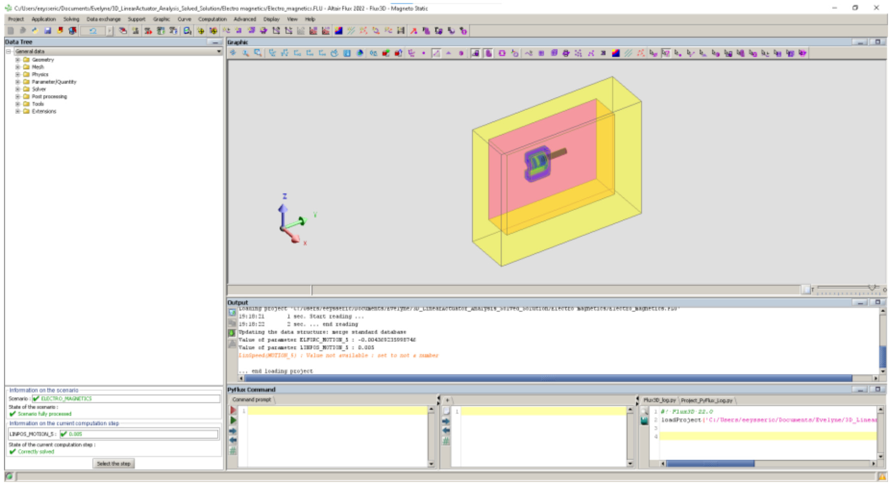
II.5 RESULT ANALYSIS

ALTAIR

POST PROCESSING

- ☞ Note: Flux is being migrated to SimLab. For now, in SimLab, there are only a few post-processing features. Until we have the equivalent of what we have in Flux in SimLab, there is still the possibility to analyze the results in Flux with a contextual menu in SimLab that allows to open directly the solved project in Flux.



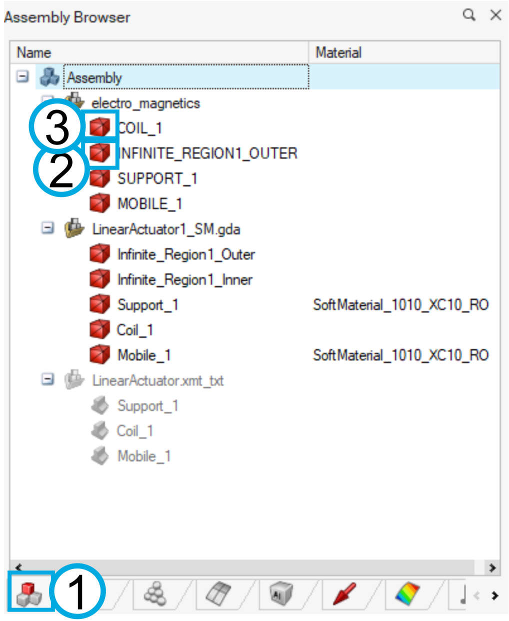


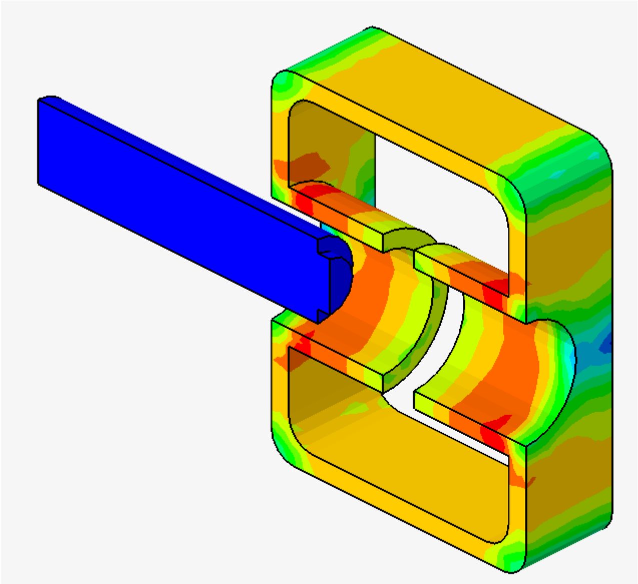
ALTAIR

POST PROCESSING

- In SimLab, hide the infinite box body and the coil body

Step	Action
1	*To the left of the graphic window, in the **Assembly Browser**:* Select the 1st tab **Assembly**
2	Click on the icon in front of INFINITE_REGION1_OUTER
3	Click on the icon in front of COIL_1



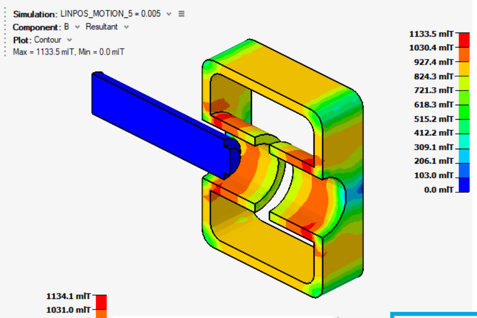


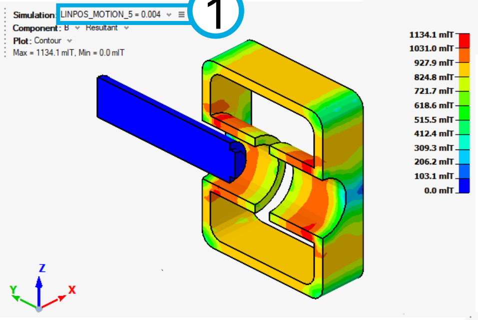
ALTAIR

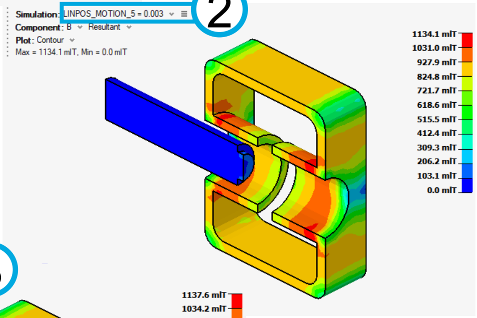
POST PROCESSING

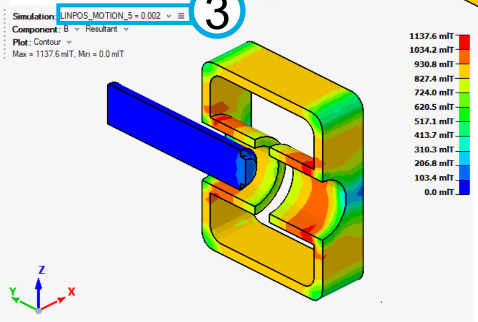
- Display magnetic flux density isovalues at 5 positions
  - 5 mm, 4 mm, 3 mm, 2 mm and 1 mm

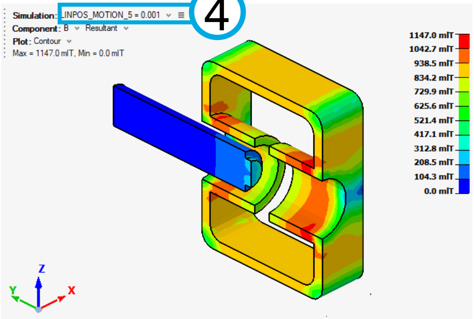
Step	Action
1	In the **Simulation** field, select LINPOS_MOTION_5=0.004
2	In the **Simulation** field, select LINPOS_MOTION_5=0.003
3	In the **Simulation** field, select LINPOS_MOTION_5=0.002
4	In the **Simulation** field, select LINPOS_MOTION_5=0.001









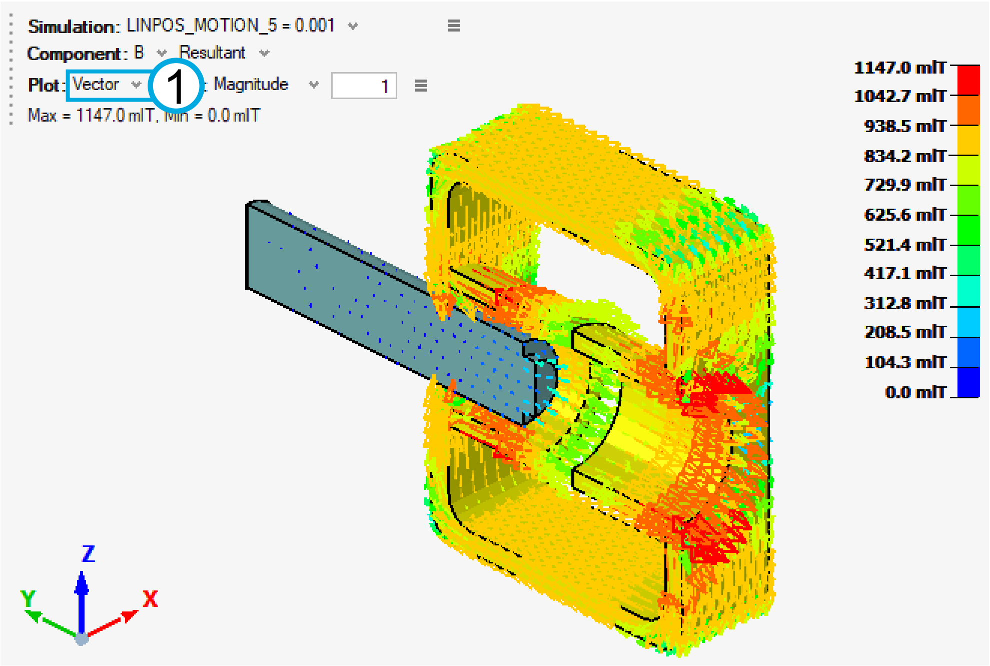


ALTAIR

POST PROCESSING

- Display magnetic flux density arrows at 1 mm

Step	Action
1	In the **Plot** field, select [Vector]

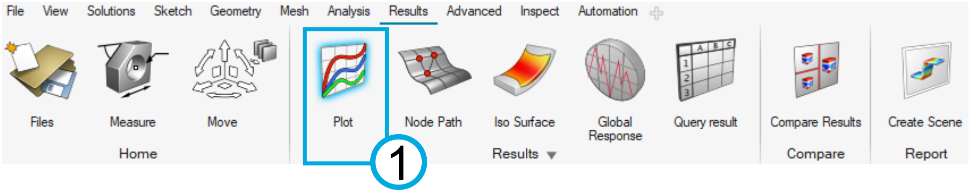


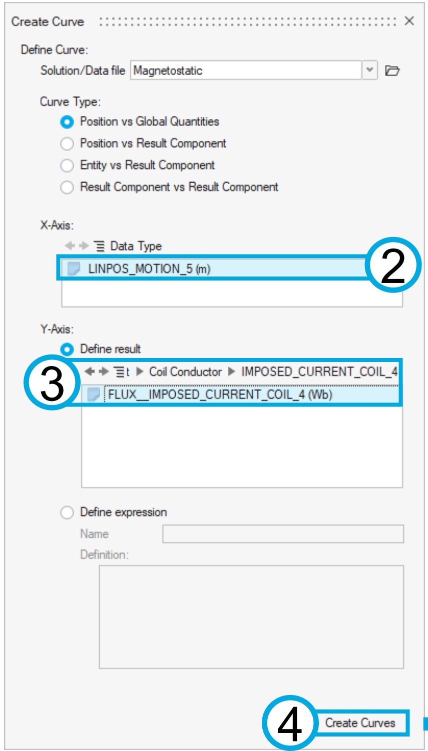
ALTAIR

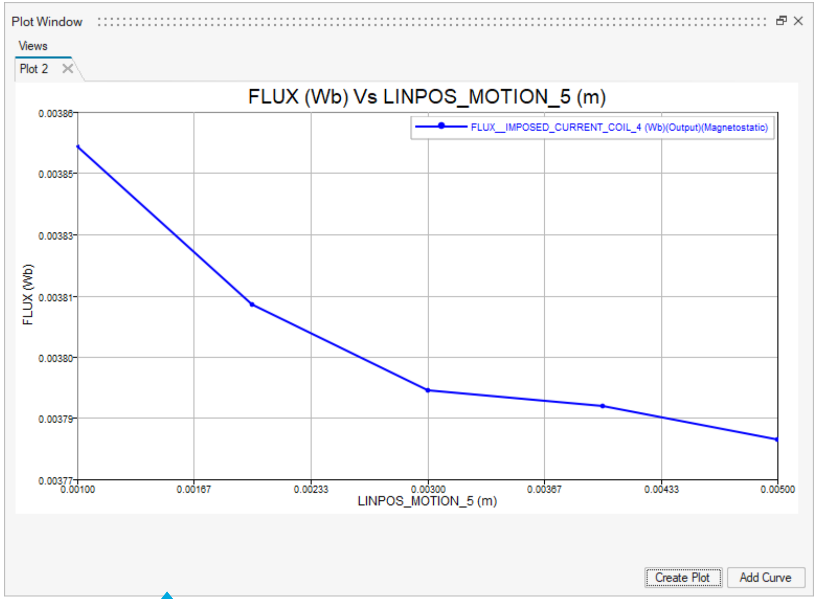
POST PROCESSING

- Curve of the magnetic flux as a function of the position

Step	Action
1	In **Results** ribbon click on **Plot**
2	Select **X- Axis** : **LINPOS_MOTION_5**
3	in Coil Conductor→IMPOSED_CURRENT_COIL_4 select **Y-Axis** : **FLUX__IMPOSED_CURRENT_COIL_4 (Wb)**
4	Click on **Create Curves**



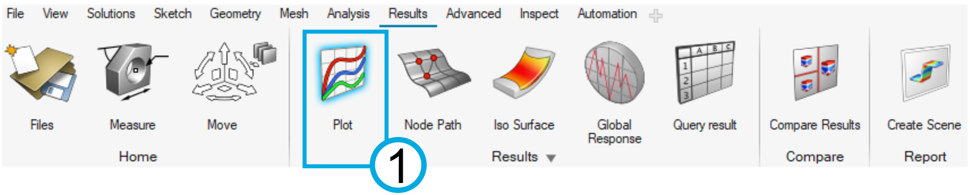




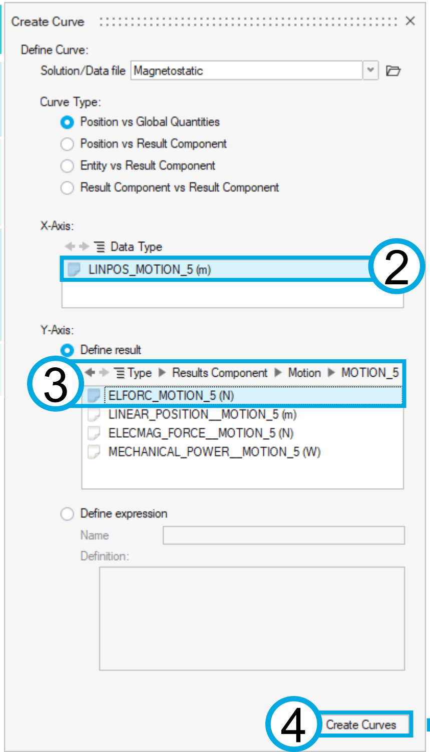
ALTAIR

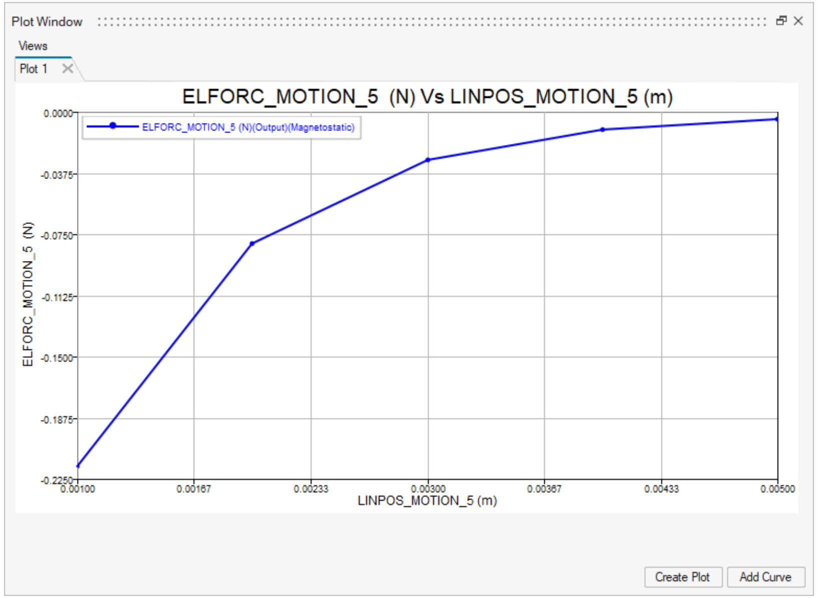
POST PROCESSING

- Curve of the magnetic force on the mobile as a function of the position



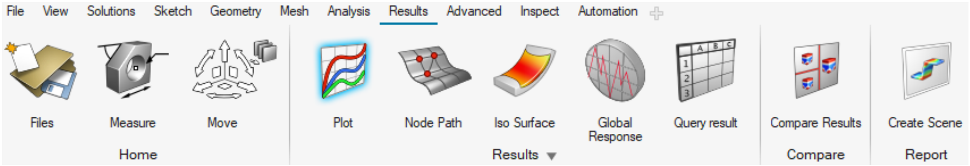
Step	Action
1	In **Results** ribbon click on **Plot**
2	Select **X- Axis** : **LINPOS_MOTION_5**
3	in Motion → MOTION_5 select **Y-Axis** : **ELFORC_MOTION_5 (N)**
4	Click on **Create Curves**





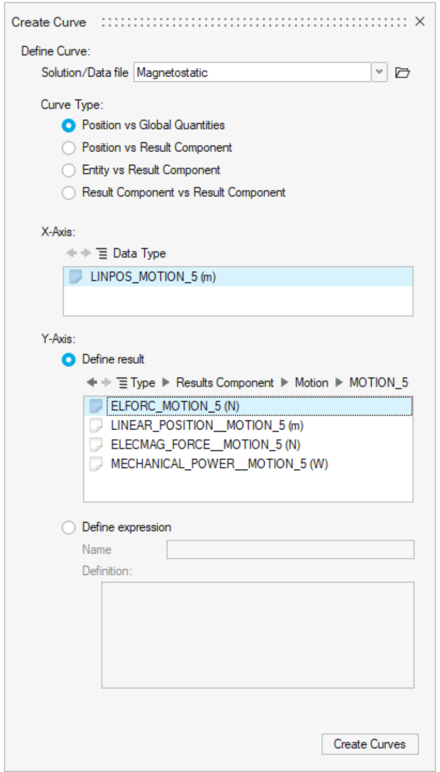
ALTAIR

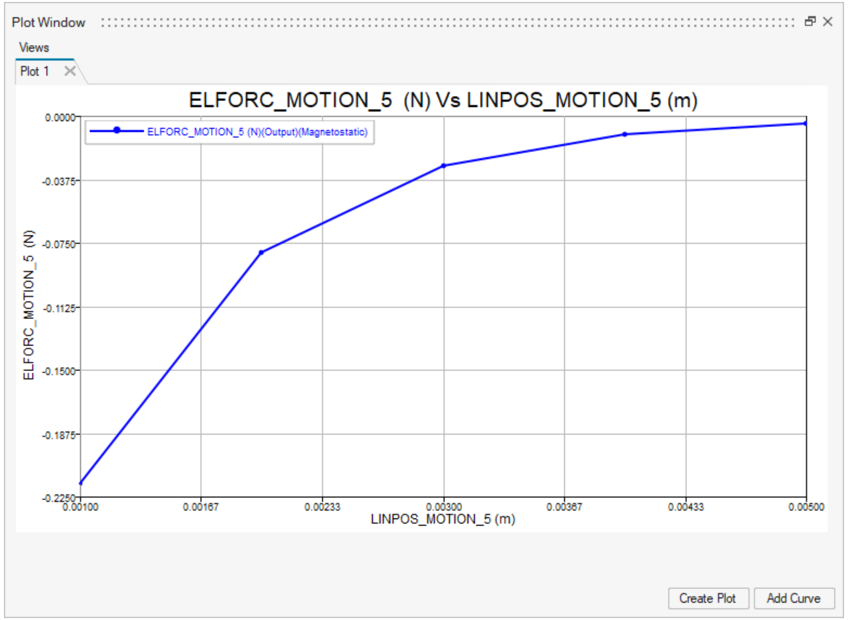
POST PROCESSING



- Curve of the magnetic force on the mobile as a function of the position

Step	Action
1	*In the 2D Plot window:* Click on the [Clear Plot] button
2	*In the 2D Plot window:* In the **Component** zone, click on [ELFORC_MOTION_5 (N)]
3	*In the 2D Plot window:* Click on the [Show Plot] button





SAVING DATABASE

- Save the “Results” database

Step	Action
1	Click on **File → Save as**
2	Save the project **3D_MS_LinearActuator_results.slb** in *...\3D_MS_LinearActuator\3D_MS_LinearActuator_StepByStep\Output*

ALTAIR

III. CONCLUSION

CONCLUSION

- **Altair Simulation Products** provide a convenient analysis process for linear actuator.
- **Flux** is used as the solver for electromagnetic problems.
- **SimLab** is used for modeling the device.

THANK YOU

altair.com

#ONLYFORWARD

ALTAIR